

Provincial Overview of Exploration and Mining in British Columbia, 2019



Ministry of Energy, Mines and Petroleum Resources

Information Circular 2020-01 Revised February, 2020





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Front Cover:

Top. A forty-niner tending a dumpbox, Lightning Creek, South Central Region, circa 1860. From Royal BC Museum Archives, reference code I-55574.

Bottom. British Columbia Geological Survey field assistant mapping in the Golden Triangle, Northwest Region. **Photo by JoAnne Nelson.**

Back Cover:

'Malachite spring', Mitchell deposit, KSM project, Northwest Region. **Photo by Lauren Wilson.**

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> > January 2020

Foreword

This volume is the latest in a series of annual reviews that dates back to 1874, when the first Annual Report of the Minister of Mines was published. Detailing significant projects region-by-region, the volume complements the British Columbia Coal Industry Overview (British Columbia Geological Survey Information Circular 2020-02).

To prepare the district chapters in this volume, the Regional Geologists visit project sites to view outcrops and drill core and to discuss results and progress. A significant amount of information is gleaned from corporate press releases, websites, and reports. Exploration expenditures, drilling estimates, and other metrics for British Columbia were captured in the British Columbia Mineral and Coal Exploration Survey. The survey is a joint initiative between the Province of British Columbia Ministry of Energy, Mines and Petroleum Resources, the Association for Mineral Exploration, and EY LLP.

As used in this volume

- grassroots exploration refers to activities that are typically below Mines Act permit thresholds and commonly include mapping, sampling and prospecting
- · early-stage exploration includes activities such as geophysics, geochemistry, trenching, and drilling
- advanced-stage exploration is concerned with resource definition, emphasizing drilling and bulk sampling, and may include baseline environmental studies, economic pre-feasibility work, and secondary target exploration
- mine evaluation begins with a commitment to develop a resource and usually coincides with government applications to open a mine and environmental, social, engineering, and financial assessment activities
- mine lease exploration represents work on a mining property beyond known reserves and commonly has characteristics of early-stage or advanced exploration

Founded in 1895, the British Columbia Geological Survey integrates historical data with active research programs and, drawing on continuously advancing concepts and technologies in the Earth sciences, informs the mineral and coal industries. The British Columbia Geological Survey preserves, archives, and provides free web-based access to more than a century's worth of geoscience information.

We appreciate the information and access to project sites provided by industry representatives, and thank George Owsiacki of Total Earth Science Services for desktop publishing.



Gordon Clarke Director, Mineral Development Office British Columbia Geological Survey January, 2020

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Exploration and Mining in British Columbia, 2019: A summary



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1. Introduction

Reflecting its complex geological history, British Columbia is endowed with diverse minerals and deposit types. British Columbia is Canada's largest exporter of coal, leading producer of copper, and only producer of molybdenum. Also produced are significant amounts of gold, silver, lead, and zinc, and more than 30 industrial minerals including gypsum, magnesite, limestone, and dimension stone. Numerous quarries produce sand and gravel or crushed aggregate. In 2019, many mineral exploration projects remained active (Fig. 1).

Flanked by the Pacific Ocean, British Columbia offers easy access to global markets. Mine operations benefit from tax incentives and a well-developed infrastructure, including low-cost electricity, an integrated road and rail network, and large deep-water ports. Exploration benefits from an extensive geoscience database and a web-based mineral tenure system.

This summary uses information from the British Columbia Coal Industry Overview (British Columbia Geological Survey Information Circular 2020-02) and incorporates the Regional Geologist reports in this volume. The Regional Geologists (Fig. 2; Table 1) represent the provincial government on geological matters at a regional level. Within their communities, they provide information on exploration trends, possible investment opportunities, land use processes, First Nation capacity building, and public outreach.

2. Mine production

The Ministry of Energy, Mines and Petroleum Resources forecasts the total value of mine production for 2019 at \$8.80 billion (Fig. 3) including coal, copper, gold, industrial minerals, aggregate, molybdenum, and silver. This is \$1.16 billion less than the 2018 preliminary Natural Resources Canada (NRCan) estimate of \$9.66 billion (Fig. 4) and is mostly due to a decrease in coal prices.

Coal prices were strong early in 2019 but declined in the summer. Having dipped as low as \$130/tonne late in the year, hard coking coal prices averaged \$183/tonne for the year. Third quarter realized prices for pulverized coal injection (PCI) products averaged \$132/tonne; the price slipped below \$100/

tonne on occasion. Thermal coal prices averaged \$99/tonne for the year. (All prices are \$US, west coast port price).

As in previous years, coal was the highest value mine product (58%) followed by copper (21%).

In 2019, ten metal mines operated during at least part of the year (Fig. 1; Table 2). Metallurgical coal was produced at five large open-pit operations in the southeastern part of the province and three open-pit operations in the northeastern part. Teck Coal Limited's **Coal Mountain** mine in the southeast ceased operations in Q2 of 2019. One underground mine on Vancouver Island produced thermal coal, but shutdown part way through the year (Fig. 1; Table 3). About 30 industrial mineral mines and more than 1000 aggregate mines and quarries were in operation.

3. Mining highlights

3.1. Metal mines

Metal mines accounted for \$2.99 billion (forecast) of all mine production in 2019, representing about 34% of total output (Fig. 3). Ten mines produced in 2019 (Fig. 1; Table 2).

In the Northwest Region producing metal mines included Brucejack, Silvertip and Red Chris. The Brucejack mine continued a production ramp up from 2700 tpd to 3800 tpd. For the first three quarters ending September 30th, production totalled 258,168 oz Au and 368,989 oz Ag from 970,659 t of ore grading 8.9 g/t Au. Gold recoveries averaged 96.9%. Newcrest Mining Limited acquired 70% interest in the Red Chris mine for a final purchase price of \$804 million US, creating a joint venture with Imperial Metals Corp. who hold the remaining 30% interest. Production to the end of the third quarter of 2019 totalled 50.2 Mlbs Cu and 24,316 oz Au, with an average daily mill throughput of 28,829 tpd. The Silvertip mine had its first year of full production after being purchased by Coeur Mining Inc. in 2017 from JDS Silvertip Holdings for \$250 million. In the first three guarters of 2019, the mine produced 174,885 t grading 192.65 g/t Ag, 6.96% Zn, and 4.80% Pb (equitable to 883,055 oz of Ag, 13,237,837 lbs of Zn, and 12,534,228 lbs of Pb).

In the North Central Region, the Mt. Milligan open-pit





Fig. 2. Geographic regions and Regional Geologist offices.

copper-gold mine is in its sixth year. Production to the end of the 3rd quarter totalled 53.1 Mlb of Cu and 137,123 Au from 11.92 Mt of ore grading 0.25% Cu and 0.52 g/t Au. Metal recoveries averaged 81.7% for Cu and 67.4% for Au.

In the South Central Region, operating mines included Copper Mountain, Gibraltar, Highland Valley, Mount Polley and New Afton. Copper Mountain Mining Corporation reported that production at Copper Mountain to the end of the 3rd quarter totalled 53.4 Mlbs Cu, 20,547 oz Au and 185,212 oz Ag from 8.6 Mt of ore grading 0.28% Cu at 79.3% recovery.

Following 2017-2018 drilling at the New Ingerbelle deposit, in 2019 Copper Mountain Mining Corporation converted resulting resources to reserves. Additional work then further increased reserves at the New Ingerbelle, North Pit, and Main Pit. Expected mine life is now 31 years, based on current reserves and planned production level.

The **Gibraltar** mine reported production to the end of the 3^{rd} quarter totalled 92.6 Mlb of Cu and 2.01 Mlb Mo from 22.0 Mt of ore. For the 3^{rd} quarter, a copper grade of 0.249% at a recovery of 87.7% was reported. Updated reserves support a projected 19-year mine life. Taseko has a multi-year permit for exploration north and northwest of the mine.

In the first nine months of 2019, Teck Resources Limited's **Highland Valley** mine milled 38.23 Mt at a Cu grade of 0.28% and recovery of 82.7%. For the full 2019 year, the company projects 115 to 120 Mt Cu and 8.8 Mlb Mo in concentrate. Mining began in the Highland Valley camp at the Bethlehem



Fig. 3. 2019 forecast value of British Columbia mineral production by commodity; total is \$8.80 billion.



Fig. 4. Value of British Columbia mineral production by year 1999-2019; value for 2018 is preliminary estimate, value for 2019 is forecast.

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.

In January 2019, Imperial Metals Corporation announced a decision to stop mining and mill low-grade stockpiles before suspending production at the **Mount Polley** mine. They placed the mine on care and maintenance at the end of May. Production to May 26 was 3.83 Mlbs Cu, 10,619 oz Au, and 11,119 oz Ag from 2.23 Mt ore milled.

Table 1. Mineral Development Office and Regional Geologist contact information.

Region	Community	Regional Geologist	Phone	email
Northwest	Smithers	Sean Tombe	250-877-2694	Sean.Tombe@gov.bc.ca
Northeast and North Central	Prince George	vacant	-	Gordon.Clarke@gov.bc.ca
South Central	Kamloops	vacant	-	Bruce.Northcote@gov.bc.ca
Southeast	Cranbrook	Fiona Katay	250-919-4724	Fiona.Katay@gov.bc.ca
Southwest	Vancouver	Bruce Northcote	604-660-2713	Bruce.Northcote@gov.bc.ca
Mineral Development Office	Vancouver	Gordon Clarke	604-660-2094	Gordon.Clarke@gov.bc.ca

Cable 2. Operating metal mines, 2019	, forecast mine production,	reserves, and resources.
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Mine	Region	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2019 Production (based on Q1- Q3)	Reserves	Resource	Comments
Brucejack	Northwest	Pretium Resources Inc.	Au, Ag; IS- epithermal; 104B 193	344,200 oz Au	P+Pr: 16 Mt grading 12.6 g/t Au and 59.3 g/t Ag	M+I: 18.7 Mt at 14.2 g/t Au and 81.6 g/t Ag Inf: 7.8 Mt at 12.0 g/t Au and 51.3 g/t Ag	May 2019 updated mineral reserves and resources.
Red Chris	Northwest	Newcrest Mining Limited (70%), Imperial Metals Corporation (30%)	Cu, Au, Ag; hybrid calc-alkalic to alkalic porphyry; 104H 005	66.9 Mlbs Cu and 32,400 oz Au	P+Pr: 301.5 Mt at 0.36% Cu, 0.27 g/t Au	2014: M+I: 1.035 Bt at 0.35% Cu, 0.35g/t Au, 1.14 g/t Ag Inf: 787.1 Mt at 0.29% Cu, 0.32 g/t Au, 1.04 g/t Ag	August 2019, Newcrest Mining Limited acquired 70% interest creating a joint venture with Imperial Metals Corporation (remaining 30% interest). First three quarters averaged 28,829 tpd.
Silvertip	Northwest	Coeur Mining Inc.	Ag, Pb, Zn; Manto carbonate- replacement; 104O 038	1,177,300 oz Ag, 17,650,700 lbs Zn, 16,713,300 lbs Pb	P+Pr: 1.61 Mt at 289 g/t Ag, 5.6% Pb, 8.24% Zn	M+I: 1.18 Mt at 222.73 g/t Ag, 4.09% Pb, 8.58% Zn Inf: 0.53 Mt at 271.04 g/t Ag, 5.02% Pb, 9.31% Zn	New mineral resource update February 2019. Regional soil sampling and induced polarization survey.
Mt. Milligan	North Central	Centerra Gold Inc.	Cu, Au, Ag; alkalic porphyry Cu- Au; 093N 194, 191	74 Mlbs Cu 190 Koz Au	P+Pr: 447.56 Mt at 0.186% Cu and 0.3 g/t Au	M+I: 342.23 Mt at 0.136% Cu and 0.2 g/t Au (additional to reserves)	Concentrator design capacity 62,500 tpd. Estimated mine life +20 years. More than 350 employees.
Copper Mountain	South Central	Copper Mountain Mining Corporation 75%, Mitsubishi Materials Corporation 25%	Cu, Au, Ag; porphyry Cu- Au: alkalic; 092HSE001	72-80 Mlb Cu, 29,500- 32,500 oz Au, 260,000- 290,000 oz Ag (management's guidance)	P+Pr: 476,795,000 t 0.23% Cu, 0.10 g/t Au 0.73 g/t Ag	M+I: 598,850,000 t 0.23% Cu, 0.10 g/t Au, 0.73 g/t Ag	0.10% Cu cut- off. Resources inclusive of reserves. Includes New Ingerbelle.
Gibraltar	South Central	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 + Mo (+/- 5%) (management's guidance)	P+Pr: 594 Mtons 0.25% Cu, 0.008% Mo	M+I: 1009 Mtons 0.25% Cu, 0.007% Mo Inf: 59 Mtons 0.21% Cu, 0.004% Mo	0.15% Cu cut- off. Resources inclusive of reserves. Does not include Cu oxide.

Highland Valley	South Central	Teck Resources Limited	Cu, Mo; porphyry Cu+/-Mo+/- Au; 092ISW012, 45	115,000- 120,000 t Cu, 8.0 Mlb Mo (management's guidance)	P+Pr: 535.5 Mt 0.300% Cu, 0.007% Mo	M: 499.4 Mt 0.30% Cu, 0.008% Mo I: 671.8 Mt 0.24% Cu, 0.009% Mo Inf: 166.0 Mt 0.21% Cu, 0.007% Mo	Resources exclusive of reserves. Evaluating plans for extension of mine life.
Mount Polley	South Central	Imperial Metals Corporation	Cu, Au, Ag; porphyry Cu- Au: Alkalic; 093A 008	3.825 Mlb Cu 10,619 oz Au 11,119 oz Ag (to shut down)	P+Pr: 53.772 Mt 0.337% Cu, 0.299 g/t Au, 0.89 g/t Ag	M+I: 194.32 Mt 0.294% Cu 0.285 g/t Au, 0.727 g/t Ag Inf: 5.619 Mt 0.374% Cu, 0.276 g/t Au, 2.187 g/t Ag	Reserves in 5 zones. Resources inclusive of reserves. Shut down mid year pending improved copper price.
New Afton	South Central	New Gold Inc.	Au, Ag, Cu; porphyry Cu- Au: Alkalic; 092INE023	215-246 koz AuEq (management's guidance)	P+Pr: 52.642 Mt 0.64 g/t Au, 1.9 g/t Ag, 0.78% Cu	M+I: 52.407 Mt 0.63 g/t Au, 2.2 g/t Ag, 0.77% Cu Inf: 13.564 Mt 0.39 g/t Au, 1.4 g/t Ag, 0.45% Cu	Resources exclusive of reserves. Ongoing exploration program.
Myra Falls	Southwest	Nyrstar Myra Falls Ltd.	Zn, Cu, Pb, Au, Ag; Noranda/ Kuroko massive sulphide; 092F 330, 71, 72, 73	na	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	Production suspended for compliance reasons end of 2018. Restarted April 2019. Underground exploration continued with 17,000 m drilling in 198 holes.

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

Table 3. Operating coal mines, 2019, forecast mine production, reserves, and resources.

Mine	Region	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2019 Production (based on Q1- Q3)	Reserves	Resource	Comments
Brule	Northeast	Conuma Coal Resources Limited	PCI; bituminous coal; 093P 007	2.62 Mt clean	P+Pr: 12.26 Mt	na	About 230 employees.
Willow Creek	Northeast	Conuma Coal Resources Limited	HCC, PCI; bituminous coal; 093O 008	820,000 t clean	P+Pr: 11.04 Mt	na	About 220 employees, mine and plant.
Wolverine	Northeast	Conuma Coal Resources Limited	HCC; bituminous coal; 093P 025	1.19 Mt	P+Pr: 26.99 Mt	na	About 300 employees, mine and plant.

Coal Mountain	Southeast	Teck Coal Limited	PCI; bituminous coal; 082GNE001	200,000 t clean	na	PCI M: 56.8 Mt I: 22.9 Mt Inf: 4.8 Mt	Mineable reserves at CMO depleted; reclamation begun; facilities also processed coal trucked from Elkview mine; facilities to be placed on care and maintenance; Coal Mountain Phase II (CMO2, Marten Wheeler) would use facilities from CMO, but project currently remains on hold.
Elkview	Southeast	Teck Coal Limited (95%); Nippon Steel & Sumitomo Metal Corp. (2.5%), POSCO (2.5%)	HCC; bituminous coal; 082GNE017	7.1 Mt clean	HCC P: 6.8 Mt Pr: 258.3 Mt	HCC M: 223.0 Mt I: 156.7 Mt Inf: 205.6 Mt	Baldy Ridge Extension (BRE) approved (2016); exploration drilling in active pits and expansion areas; coal quality testwork; P+Pr reserves expected to support approximately 38 more years at the current production rate.
Fording River	Southeast	Teck Coal Limited	HCC; bituminous coal; 082JSE012	8.15 Mt clean	HCC P: 166.4 Mt Pr: 221.5 Mt	HCC M: 407.6 Mt I: 925.5 Mt Inf: 775.6 Mt	EA approval of Swift expansion (2015); exploration drilling in active pits and expansion areas; coal quality testing; geophysical work and exploration in future expansion areas; pilot water treatment construction; P+Pr reserves are projected to support a further 43 years of mining at current production rate.
Greenhills	Southeast	Teck Coal Limited (80%); POSCAN (20%)	HCC bituminous coal; 082JSE007	6.1 Mt clean	HCC P: 9.7 Mt Pr: 155.3 Mt	HCC M: 162.2 Mt I: 247.2 Mt Inf: 177.1 Mt	Cougar Pit Expansion (CPX) approved (2016); exploration drilling in expansion areas; coal quality testing; P+Pr reserves are projected to support another 28 years of mining at the current planned production rates.

Table	3.	Continued.

Line Creek	Southeast	Teck Coal Limited	HCC, TC; bituminous coal; 082GNE020	3.95 Mt clean	HCC P: 2.4 Mt Pr: 57.8 Mt TC P: 0.4 Mt Pr: 10.1 Mt	HCC M: 312.2 Mt I: 406.5 Mt Inf: 372.8 Mt TC M: 1.7 Mt I: 1.9 Mt Inf: 1.8 Mt	Burnt Ridge Extension (BRX) approved (2016); pre-stripping on Mount Michael (LCO2); exploration drilling and coal quality test work in expansion areas; Additional of treatment process to West Line Creek water treatment facility, with further design optimization underway; P+Pr reserves at Line Creek are projected to support another 18 years of mining at planned production rates.
Quinsam	Southwest	Quinsam Coal Corporation (ERP Compliant Fuels LLC)	Thermal coal; bituminous coal; 092F 319	na	na	Not reported. Unofficial, noncompliant Resources estimated at 40 Mt in 2013 by mine staff.	Placed on care and maintenance May 2019 and operator filed for bankruptcy in July. Produced about 200,000 t in 2018, the last full year of production.

HCC = hard coking coal; PCI = pulverized coal injection; TC = thermal coal; ULV = ultra low volatile P = Proven; Pr = Probable; M = Measured; I = Indicated; Inf = Inferred

New Gold Inc. reported production to the end of the 3rd quarter for **New Afton** totalling 61.2 Mlb of Cu, 53,051 oz Au from 4.125 Mt of ore grading 0.81% Cu and 0.49 g/t Au. Metal recoveries averaged 83.3% for Cu and 82.3% for Au.

3.2. Coal mines

Nine coal mines (Fig. 1; Table 3) accounted for a forecast production of \$5.08 billion for 2019. This production represents about 58% of all total mineral output in the province. Coal was produced at five large open-pit operations of Teck Coal Limited in southeastern British Columbia, three open-pit operations of Conuma Coal Resources Limited in northeastern British Columbia, and one underground operation of Quinsam Coal Corporation on Vancouver Island. During the year, Teck's **Coal Mountain** mine and Quinsam's **Quinsam** mine suspended operations.

3.3. Industrial minerals, aggregates, and jade

About 30 industrial mineral mines and more than 1000 aggregate operations are active in British Columbia (selected operations are listed in Table 4). With forecast production figures for industrial minerals of \$430 million (4.9% of total mineral production) and for aggregates of \$300 million (3.4% of total mineral production), these operations are important to

the economy of the province. British Columbia produces the world's best quality nephrite jade. The Northwest Region was the most active for jade producers.

In the Northeast Region, Fireside Minerals Ltd. mines veins of massive white barite. The barite is crushed and bagged on site and trucked to Fort St. John and Alberta for use in the drilling industry. In the South Central Region, industrial mineral commodities produced include roofing granules (from basalt), limestone, dimension stone, opal, railway ballast, diatomaceous earth, and zeolite. The Southeast Region hosts several industrial mineral mines, the largest of which are in the Rocky Mountain foreland belt. Commodities produced include magnesite, silica, gypsum, graphite, mineral wool, and abrasives. In the Southwest Region a number of operations remained in steady production and continue to be a major employer.

4. Mine development projects

As used herein, the term 'mine development projects' refers to those where the decision to produce has been made, necessary permits have been acquired, financing has been secured, and on-site construction has started. In 2019, only CertainTeed Gypsum Canada Inc.'s **Kootenay West** project (Fig. 1; Table 5) was considered under development.

Fable 4. Selected operating industrial mineral mines and	quarries, 2019.	, forecast mine production	, reserves, and resources.
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Mine	Region	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2019 Production (based on Q1-Q3)	Reserves	Resource	Comments
Anyox	Northwest	True-Grit Abrasives	Slag steel	na	na	na	Slag is mined, cleaned, and barged for roofing and sand for sand blasting.
Cassiar Jade	Northwest	Dynasty Jade Ltd.	Nephrite jade; gems and semi- precious stones; 104P 005	na	na	na	Trenching, quarrying, placer production.
Dean Kutcho	Northwest	Cassiar Jade Contracting Inc.	Nephrite jade; gems and semiprecious stones; 104I 078	na	na	na	Mining.
Jade Valley	Northwest	United Oriental Mining Ltd.	Nephrite jade; gems and semi- precious stones	na	na	na	Trenching, quarrying, placer production.
Kaien Creek	Northwest	Terus Construction Ltd.	Industrial rock; crushed rock	na	na	na	Drilling, blasting, crushing, production for CN Railway and LNG projects.
Kutcho Creek Jade	Northwest	Continental Jade Ltd.	Nephrite jade; gems and semi- precious stones; 104I 078	na	na	na	Mining, trenching.
Letain	Northwest	Cassiar Jade Contracting Inc.	Nephrite jade; gems and semi- precious stones; 104I 079	na	na	na	Mining, trenching.
Polar Jade	Northwest	Glenpark Enterprises Ltd.	Nephrite jade; gems and semi- precious stones; 1041 083	na	na	na	Mining, trenching.
Provencher	Northwest	Glenpark Enterprises Ltd.	Nephrite jade; gems and semi- precious stones; 1041 092	na	na	na	Mining, trenching.
Rainbow Lake South	Northwest	Spring Creek Aggregates Ltd.	Industrial rock; crushed rock	na	na	na	Drilling, blasting, crushing, production for CN Railway and LNG projects.
Ridley Island	Northwest	Terus Construction Ltd.	Industrial rock; crushed rock	na	na	na	Drilling, blasting, crushing, production for CN Railway and LNG projects.
Robinson Lake Trail	Northwest	Haisla & Progressive Ventures Construction Ltd.	Industrial rock; crushed rock	na	na	na	Drilling, blasting, crushing, production for CN Railway and LNG projects.

Sand Hill	Northwest	Terus Construction Ltd.	Industrial rock; crushed rock	na	na	na	Crushing for CN Railway and LNG projects.
Wolverine	Northwest	Cassiar Jade Contracting Inc.	Nephrite jade; gems and semi- precious stones	na	na	na	Mining and trenching.
Fireside	Northeast	Fireside Minerals Ltd.	Barite; vein barite; 094M 003, 019	30,000 t	P+Pr: 475,000 t (non-NI 43-101 compliant)	na	Mined from the Moose Pit. With possible extension to north.
Ashcroft	South Central	IG Machine and Fibers Ltd. (IKO Industries Ltd.)	Basalt (roofing granules); 092INW104	300,000 t	na	Approx. 13.3 Mt in 2002	Typically mines 500,000 t with 60% processed into granule products.
Bromley Creek (Zeotech)	South Central	Canadian Zeolite Corp.	Zeolite; open system zeolites; 092HSE243	na	na	M+I: (as of 2013-06-30): 550,000 t	Operating by Absorbent Products Ltd.
Bud	South Central	Absorbent Products Ltd.	Bentonite; 092HSE162	na	na	na	Operating, but volumes not published.
Falkland	South Central	Lafarge Canada Inc.	Gypsum; 082LNW001	na	na	na	Production affected by shut down of Lafarge's Kamloops Cement Plant.
Kettle Valley Quarries	South Central	Kelowna Sand and Gravel Ltd./Kettle Valley Stone Company	Ashlar, flagstone, thin veneer; 082ENW109, 111, 112	na	na	na	
Nazo	South Central	Can Lava Mining Corporation	Lava rock; cinder cone; 093B 060	na	na	Historical: 45 Mt	1998 resource estimate. Exploration permitted on adjacent property.
Red Lake	South Central	Absorbent Products Ltd.	Diatomaceous earth; lacustrine diatomite; 092INE081	na	na	na	Operating but volumes not published.
Z-1	South Central	ZMM Canada Minerals Corp.	Zeolite; open system zeolites; 092INW095	9000 t	na	Approx. 800,000 t	Historical resource.
Elkhorn	Southeast	CertainTeed Gypsum Canada Inc.	Gypsum; evaporitic bedded gypsum; 082JSW021	Gypsum: 300,000 t; Anhydrite: 120,000 t	na	na	Mine expected to remain open until 2023; the company will replace production by developing the Kootenay West mine (EAO certificate granted in 2018).

Moberly Silica	Southeast	HCA Mountain Minerals Limited (Northern Silica Corporation)	Silica; industrial use silica, frac sand; 082N 001	na	20 to 140 mesh frac sand (dry) P: 8.9 Mt of 64% frac sand + Pr: 4.6 Mt of 64% frac sand (2014)	M+I: 30 to 140 mesh frac sand (dry): 37.5 Mt at 70% frac sand + 11.3 Mt silica as frac sand residues (2016)	Drilling (7 DDH, 1900 m); mapping, sampling, thin section work; design modifications to processing plant.
Mount Brussilof	Southeast	Baymag Inc.	Magnesite; hydrothermal sparry magnesite; 082JNW001	230,000 t	P: 50 Mt	na	MgO, and MgOH; sediment-hosted sparry magnesite.
Winner	Southeast	Rockwool Inc.	Gabbro/basalt; crushed rock for mineral wool; 082ESE265	Quarrying feed stock for mineral wool plant	na	na	Crushing, screening, stockpiling; environmental monitoring.
Cox Station	Southwest	Mainland Construction Materials	Aggregate; R15: crushed rock; 092GSE103	Typically, 2-3 Mtpy	na	na	
СТСТ	Southwest	Vancouver Island Marble Quarries Ltd.	Marble; R09:limestone; 092E 020	Typically about 400 t annually	na	na	Supplies Matrix Marble and Stone Inc.
Earle Creek	Southwest	Lafarge Canada Inc.	B12: sand and gravel	Typically >1 Mtpy	na	na	
Vulcan/Salal	Southwest	Garibaldi Pumice Ltd.	Pumice; volcanic ash; 092JW 039	Approx. 20,000 m ³ annually	na	11,396,000 m ³ pumice 4,990,000 m ³ pumicite (fines)	2014 resource. Additional exploration 2015, 2018.
K2	Southwest	K2 Stone Quarries Inc.	Dimension stone, flagstone; 092C 159	15,000- 20,000 t annually	na	na	Number represents material extracted.
Orca	Southwest	Polaris Minerals Corporation	B12: sand and gravel	Up to 6 Mtpy	P+Pr: 121.6 Mt (2005)	M+I: 134.1 Mt (2005)	Subsidiary of U.S. Concrete Inc. Exports to USA.
Pitt River	Southwest	Lafarge Canada Inc.	Aggregate; R15: crushed rock; 092GSE007	Typically > 1 Mtpy	na	na	
Sechelt	Southwest	Lehigh Hanson Materials Limited	B12: sand and gravel	Typically > 1 Mtpy	na	Several decades	
Sumas Shale	Southwest	Sumas Shale Ltd. (Lafarge Canada Inc., Clayburn Industrial Group)	Shale, clay, sandstone; B05; residual kaolin; 092GSE024	About 500,000 t annually	na	50+ years	Approximately 55% shale, 45% sandstone for cement production.

Texada Quarry	Southwest	Texada Quarrying Ltd. (Lafarge Canada Inc.)	Limestone, aggregate; limestone; 092F 395	na	na	100+ years	Mostly produces limestone for cement manufacture. High brightness carbonate and aggregates also produced
							produced.

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

Table 5. Mine development projects.

Mine	Region	Operator (partner)	Commodity; deposit type; MINFILE	Reserves	Resource	Comments
Kootenay West	Southeast	CertainTeed Gypsum Canada Inc.	Gypsum; evaporitic bedded gypsum; 82JSW005, 20	na	North and South quarries: Total 16.9 Mt (at average quality of 83-85%)	Granted a conditional EA certificate in January, 2018; environmental baseline work, permitting, and modifications to mine design; construction began in 2019; 400,000 tpy; 43-year mine life; blended product to market specifications.

4.1. Kootenay West (CertainTeed Gypsum Canada Inc.)

CertainTeed Gypsum's **Kootenay West** project is a new gypsum mine under construction in the Southeast Region. The operation plans to produce 400,000 tpy over a 43-year mine life.

5. Selected proposed mine or quarry projects

Projects at the proposed mine or quarry (or mine evaluation) stage have a resource defined or largely defined and are at least preparing to submit a project description to initiate the environmental assessment process or are waiting on permit amendments. Projects that have permits in place but have yet to obtain financing to begin site construction are also considered to be at the proposed stage. Selected projects (Fig. 1; Table 6) discussed below are grouped by region and commodity types.

5.1. Northwest Region

Proposed metal mines include Galore Creek Mining Corporation's **Galore Creek** project, Seabridge Gold Inc.'s **KSM** project, Kutcho Copper Corp.'s **Kutcho** project and Ascot Resources Ltd.'s **Red Mountain** project. Telkwa Coal Ltd., a subsidiary of Allegiance Coal Ltd., is proposing to develop the **Tenas** coal mine project.

5.1.1. Proposed metal mines

The **Galore Creek** gold-copper project is operated by the Galore Creek Mining Corporation (GCMC). Ownership of GCMC is equally split between Teck Resources Limited and Newmont Corporation. Newmont purchased 50% interest from Novagold Resources Inc. in July 2018. Newmont and Teck announced that they will complete prefeasibility studies

over three to four years with an annual budget of \$10 to \$15 million (50% basis). The project consists of 13 known zones of gold-copper mineralization with Proven plus Probable reserves reported as 528 Mt at 0.59% Cu, 0.32 g/t Au, and 6.02 g/t Ag.

Kucho Copper Corp.'s **Kutcho** project entered the environmental assessment and permitting process in September 2019. The deposit has Probable reserves of 10.4 Mt grading 2.01% Cu, 3.19% Zn, 0.37 g/t Au and 34.61 g/t Ag, with a Measured plus Indicated resource of 17.26 Mt at 1.85% Cu, 2.72% Zn, 0.49 g/t Au, and 33.9 g/t Ag. The average annual production is expected to be 33 Mlbs of Cu and 42 Mlbs of Zn.

Seabridge Gold Inc. continued work on their KSM porphyry copper-gold project. The project consists of four porphyry Cu-Au deposits: Kerr, Sulphurets, Mitchell, and Iron Cap. The deposits represent what may be the largest undeveloped copper-gold camp in the world (by reserves). Proven plus Probable reserves are reported as 2.198 Bt grading 0.55 g/t Au, 0.21% Cu, 2.6 g/t Ag, and 42.6 g/t Mo. Measured plus Indicted resource estimate totals 2.902 Bt grading 0.54 g/t Au, 0.21% Cu, 2.7 g/t Ag, and 44 ppm Mo. Seabridge received federal and provincial approval of its environmental assessment in 2014 and is seeking partnership to enter construction. The focus of exploration work in 2019 was to evaluate potential for additional porphyry Au-Cu systems below the Sulphurets thrust fault, follow up high-grade epithermal Au mineralization in the Sulphurets deposit, and expand on the Sulphurets resource estimate.

The **Red Mountain** project is a proposed high-grade underground gold mine. In March of this year, Ascot Resources completed the acquisition of the Red Mountain project from IDM Mining, who received its Environmental

Table 6. Selected proposed mine projects.

Project	Region	Operator (partner)	Commodity; deposit type; MINFILE	Reserves	Resource	Comments
Galore Creek	Northwest	Galore Creek Mining Corporation (Teck Resources Limited (50%)), Newmont Corporation (50%)	Cu, Au, Ag; alkaline porphyry; 104G 090	P+Pr: 528 Mt at 0.59% Cu, 0.32 g/t Au, 6.02 g/t Ag	M: 256.8 Mt at 0.72% Cu, 0.36 g/t Au I: 846.7 Mt at 0.39% Cu, 0.23 g/t Au Inf: 198.1 Mt at 0.27% Cu, 0.21 g/t Au	25,000 m of drilling. Metallurgical, geotechnical, resource, and brownfield exploration. Geological mapping, lidar, and stream-sediment sampling.
KSM	Northwest	Seabridge Gold Inc.	Au, Cu, Ag, Mo; calc-alkaline porphyry; 104B 191	P+Pr: 2.198 Bt at 0.55 g/t Au, 0.21% Cu, 2.6 g/t Ag, 42.6 g/t Mo	M+I: 2.902 Bt at 0.54 g/t Au, 0.21% Cu, 2.7 g/t Ag, 44 g/t Mo Inf: 2.719 Bt at 0.35 g/t Au, 0.32% Cu, 2.0 g/t Ag, 29 g/t Mo (Total for KSM deposits)	Exploration work to evaluate potential for additional Au-Cu porphyry systems below the Sulphurets thrust fault, follow up high-grade epithermal gold mineralization in the Sulphurets deposit, and expand the Sulphurets resource estimate.
Kutcho	Northwest	Kutcho Copper Corp.	Cu, Pb, Zn; Noranda/ Kuroko VMS; 104I 060	Pr: 10.4 Mt at 2.01% Cu, 3.19% Zn, 0.37 g/t Au, 34.6 g/t Ag	M+I: 17.26 Mt at 1.85% Cu, 2.72% Zn, 0.49 g/t Au, 33.9 g/t Ag	Mineralogical study to determine the variability and abundance of copper sulphide minerals.
Red Mountain	Northwest	Ascot Resources Ltd.	Au, Ag; subvolcanic and precious metal veins; 103P 086	P+Pr: 1.95 Mt at 7.53 g/t Au, 21.9 g/t Ag	M+I: 3.19 Mt at 7.63 g/t Au, 21.02 g/t Ag Inf: 0.41 Mt at 5.32 g/t Au, 7.33 g/t Ag	March 2019: Ascot purchased the project from IDM Mining for \$45 million.
Tenas	Northwest	Allegiance Coal Ltd. (95%), Itochu Corp. (5%)	Coal; metallurgical coal; 093L 156	P+Pr: 62.9 Mt coal	na	Entered provincial Environmental Assessment process in November of 2018 estimated to produce approximately 775,000- 825,000 t of steelmaking- coal annually with a mine- life of ~25 years.
Murray River	Northeast	HD Mining International Ltd.	Coal; bituminous; 0931 035	P: 261.6 Mt mineable coal	M+I: 314.2 Mt in situ; Inf: 373.9 Mt coal in situ	Provincial and Federal EA certificates in place. Mine plan and reclamation program approved April 2018. Would produce 6 Mtpy from two longwall faces over 25-year mine life with 764 direct jobs.
Sukunka	Northeast	Glencore Canada Corporation	Coal; Bituminous 093P 014	na	145.0 Mt coal in situ	20+ year mine life at 1.5- 2.5 Mt saleable coal per year, 250 permanent jobs once operational. Permitting in progress.

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Wapiti East	Northeast	Fertoz International Inc.	P ₂ O ₅ ; Sedimentary phosphate deposits; 093I 008, 22, 15	na	I+Inf: 1.54 Mt 21.6% P ₂ O ₅	Permitting in progress. Proposed seasonal shallow open pit mine with annual production of less than 75,000 t over a +20year mine life.
Wolverine- Herman Amendment	Northeast	Conuma Coal Resources Limited	Coal; bituminous; 093I 031	P: 10.7 Mt Pr: 3.6 Mt	M: 15.0 Mt I: 15.6 Mt Inf: 9.6 Mt	Drilling (6 DD, 1937 m, 6 RC, 721 m, Sonic, 26, 780 m).
Aley	North Central	Taseko Mines Ltd.	Nb; Carbonatite- hosted; 094B 027	P+Pr: 83.8 Mt at 0.50% Nb ₂ O ₅ (at 0.30% Nb ₂ O ₅ cut-off)	M+I: 285.8 Mt at $0.37\% \text{ Nb}_2\text{O}_5$ (at $0.20\% \text{ Nb}_2\text{O}_5$ cut- off)	Proposed open-pit mine with 10,000 tpd ore processing rate and average annual production of 9000 t Nb over a 24-year mine life. In 2019, environmental monitoring, pilot plant to provide product samples.
Blackwater	North Central	New Gold Inc.	Au, Ag; Epithermal Au-Ag-Cu (intermediate sulphidation); 093F 037	P+Pr: 334.4 Mt at 0.74 g/t Au, 5.5 g/t Ag, containing 8.17 Moz Au, 60.8 Moz Ag (combined direct processing and low grade)	M+I: 61.32 Mt at 0.71 g/t Au, 4.4 g/t Ag, containing 1.40 Moz Au, 8.73 Moz Ag (combined direct processing and low grade, exclusive of reserves)	Received Federal and Provincial Environmental Assessment certificates. Drilling (3 DDH, 342 m, 12 sonic/air rotary, 750 m). Proposed open-pit mine with 60,000 tpd ore processing rate and life-of-mine average annual production of 413 Koz Au and 1.74 Moz Ag over a 17-year mine life.
Giscome	North Central	Graymont Western Canada Inc.	CaCO ₃ ; limestone; 093J 041, 25	na	I: >100 Mt of limestone (>95% calcium carbonate, <5% magnesium carbonate) in situ	Environmental Assessment under review. Proposed 600,000 tpy limestone quarry to feed a vertical lime kiln producing 198,000 t of lime annually over a 50+ year mine life.
Kemess Underground (KUG)	North Central	Centerra Gold Inc.	Cu, Au, Ag; porphyry Cu±Mo±Au; 094E 021	Pr: 107.38 Mt at 0.27% Cu, 0.54 g/t Au, 1.99 g/t Ag; containing 629.6 Mlbs Cu, 1.87 Moz Au, 6.88 Moz Ag	I: 246.4 Mt at 0.22% Cu, 0.42 g/t Au, 1.75 g/t Ag; containing 1195 Mlbs Cu, 3.33 Moz Au, 13.87 Moz Ag (inclusive of reserves)	Permitted, proposed underground panel cave mine with 24,600 tpd ore processing rate and life- of-mine average annual production of 106,000 oz Au and 47 Mlbs Cu over a 12- year mine life.
Ajax	South Central	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 grading 0.29% Cu, 0.19 g/t Au, 0.39 g/t Ag	(M+I: NSR cut-off US\$7.10/t): 568 Mt grading 0.26% Cu, 0.18 g/t Au, 0.35 g/t Ag	Environmental certification denied by provincial (2017) and federal ministers (2018).

Bralorne	South Central	Avino Silver and Gold Mines Ltd.	Au; Au quartz veins; 092JNE001	na	M+I: 577,559 t grading 9.6 g/t Au	Past producer 1900-1971. Operated on a trial basis 2010-2014. New 100 tpd permit in 2017. Exploration in 2018 included drilling, airborne and ground geophysics, mapping, and geochemical sampling.
Cariboo Gold	South Central	Barkerville Gold Mines Ltd. (acquired by Osisko Gold Royalties Ltd.)	Au; Au-quartz veins; 093H 140, 139, 19, 6	na	M+I (cut-off 3.0 g/t Au): 13.495 Mt 5.6 g/t Au Inf: (3.0 g/t cut- off): 11.936 Mt 5.0 g/t Au	PEA has u/g mine with 11-year mine life, average 185,000 oz/y Au. In EA pre-application stage. Exploration continued with 91,000 m drilling.
New Prosperity	South Central	Taseko Mines Limited	Cu, Au; porphyry; 092O 041	P+Pr: NSR cut-off \$5.50/t: 831 Mt grading 0.23% Cu and 0.41 g/t Au; containing (recoverable) 3.6 Blb Cu; 7.7 Moz Au	M+I (cut-off 0.14% Cu): 1010 Mt grading 0.24% Cu; 0.41 g/t Au	Project at post-decision stage. Granted provincial environmental certificate but denied federal approval. Exploration and site evaluation proposed in 2019 but deferred pending a new legal challenge.
Ruddock Creek	South Central	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 grading 6.50% Zn, 1.33% Pb	Project at environmental assessment pre-application stage. Exploration drilling continued in 2019. Highlight 40.9 m 16.83% Zn, 3.46% Pb, 4.74 g/t Ag. Japan Oil, Gas and Metals National Corporation earning an interest.
Spanish Mountain	South Central	Spanish Mountain Gold Ltd.	Au, Ag; Au-quartz veins; 093A 043	na	M+I (cut-off 0.15 g/t Au): 273.2 Mt grading 0.47 g/t Au, 0.71 g/t Ag Inf: 52.4 Mt 0.37 g/t Au, 0.67 g/t Ag	Project at environmental assessment pre-application stage. Preliminary economic assessment updated in 2019.
Yellowhead	South Central	Taseko Mines Limited	Cu, Au, Ag; Noranda/ Kuroko; 082M 008, 9	P+Pr (cut- off 0.14% Cu): 716 Mt grading 0.26% Cu, 0.029 g/t Au, 1.18 g/t Ag	M+I (cut-off 0.2% Cu): 815 Mt 0.28% Cu, 0.030 g/t Au, 1.3 g/t Ag	BC Environmental Assessment Office terminated EA process 2018. Taseko Mines Limited acquired the project and plans to advance it.

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Table	6.	Continued.

Black Crystal	Southeast	Eagle Graphite Corp.	Graphite; metamorphic hosted flake graphite; 082FNW260, 283	na	Regolith+calc- silicate; M+I: 19.23 Mt at 1.35% fixed carbon Inf: 23.92 Mt at 1.3% fixed carbon (2018)	Research and development; possible application for Li- ion batteries.
Crown Mountain	Southeast	NWP Coal Canada Ltd. 80% (Bathurst Resources Ltd. 20%)	Coal (HCC and PCI); open-pit; 082GNE018	HCC: P: 42.60 Mt Pr: 4.91 Mt PCI: P: 7.13 Mt Pr: 1.19 Mt (2014)	HCC+PCI: M: 68.9 Mt I: 6.0 Mt (2014)	Option agreement with Bathurst Resources Limited, with ability to earn 50% with investment of \$121.5 M; Pre-application of EA (2014); Application Information requirements (AIR) received in April (2018); coal quality test work; water quality and treatment studies involving passive biological treatment; engineering studies and mine design; bankable feasibility study; 16-year mine life; 1.7 Mtpy.
Driftwood Creek	Southeast	MGX Minerals Inc.	Magnesite; hydrothermal sparry magnesite; quarry; 082KNE068	na	M+I: 7.847 Mt grading 43.27% MgO Inf: 55.8 Mt (2016; using cut-off grade of 42.5% MgO)	Preliminary Economic Assessment: 169,700 t of MgO, average grade of 43.27% MgO, 19-year mine life, 2.4:1 strip ratio; scoping study underway; environmental baseline studies; 100 t bulk sample; preliminary test work indicates recovery rates of 93.4% reverse flotation and removal of up to 70% silica and 30% calcium oxides; bulk of resource is within 100 m of surface; 2016 drilling extended the zone; 20 year mine lease acquired.
Michel Coal	Southeast	North Coal Limited	Coal (HCC and PCI); open-pit and underground; 082GSE050	na	HCC: M: 44.6 Mt I: 42.5 Mt; open-pit and underground (2015)	Entered pre-application of EA in 2015, re-submission of their project description in September (2018) to include all 3 mining areas; geotechnical studies and updates to mine design; coal quality testing indicates coal has similar characteristics to Elk Valley hard coking coal; drilling identified 20 coal seams with cumulative thickness of 70 m (14% of a 504 m section in the Mist Mountain Formation).

Black Bear	Southwest	Polaris Materials Corporation (Parent company US Concrete, Inc.)	Aggregate; R15; na	na	na	Orca environmental certificate amendment Application Information Requirements approved for proposed 250,000 tpy near the Orca quarry.
BURNCO Aggregate	Southwest	BURNCO Rock Products Ltd.	Aggregate; B12: sand and gravel; na	na	Approx. 20 Mt	Has environmental certification.
Sechelt Carbonate	Southwest	Ballinteer Management Inc.	Limestone, dolostone, aggregate; R09: limestone; R10: dolomite; R15: crushed rock; 093GNW031	na	Carbonate Rock: 76.1 Mt Gabbro: >700 Mt	Proponent requests project remain in environmental assessment pre-application stage.

HCC = hard coking coal; PCI = pulverized coal injection; TC = thermal coal; P = Proven; Pr = Probable; M = Measured; I = Indicated; Inf = Inferred

Assessment Certificate in October of 2018. Ascot purchased the Red Mountain project for \$45 million and the project has an estimated capital development cost of approximately \$145 million. In 2019, Ascot Resources published a mineral resource estimate that built on the estimate IDM published in 2016. Forty drill holes completed late in 2018 increased the gold resource by 200,000 oz and the Measured plus Indicated resources are now reported at 3.19 Mt grading 7.63 g/t Au and 21.02 g/t Ag, with an additional Inferred resource of 0.41 Mt grading 5.32 g/t Au and 7.33 g/t Ag. In 2017, a Proven plus Probable reserve of 1.95 Mt at 7.53 g/t Au, 21.9 g/t Ag was reported.

5.1.2 Proposed coal mines

Telkwa Coal Ltd., a subsidiary of Allegiance Coal Ltd., is proposing to develop the Tenas project, which is 25 km south of Smithers and 7 km southwest of the community of Telkwa. Itochu Corp. has a 5% interest. The Telkwa coalfield produced 433,000 t of thermal coal from rocks of the Skeena Group (Early Cretaceous) between 1918 and 1970. Currently there are four separate pits on approximately 1050 ha, where the current focus is the Tenas pit. The project has entered the provincial Environmental Assessment process. It is estimated that the project would produce approximately 775,000-825,000 t of steelmaking coal annually with a mine-life of about 25 years. In 2017, the company released a reserve estimate of Proven plus Probable reserves of 62.9 Mt of coal. In 2019, 47 drill holes were completed to obtain additional coal quality and geotechnical information, and 600 m of sonic drilling was completed for geotechnical design and proposed waste-rock locations. Additional groundwater monitoring wells were installed throughout the property.

5.2. Northeast Region

Proposed mines in the Northeast Region include HD Mining International Ltd.'s **Murry River**, Glencore Canada Corporation's **Sukunka** and Conuma Resources Limited's **Wolverine-Herman Amendment** coal projects. Fertoz International Inc. proposes the **Wapiti East** industrial mineral mine (phosphate).

5.2.1. Proposed coal mines

Murray River is a proposed underground mine that would extract metallurgical coal from the Gates Formation. In 2015, HD Mining International Ltd. completed bulk sampling for testing coal quality, processing, and marketability. In April 2018, the company received its Mines Act permit. An adit, driven to collect the bulk sample in 2015 but also to be used for the mining conveyor, descends 1.3 km down a decline. Two vertical shafts are to be completed, one for moving staff and equipment, and the other for ventilation. HD Mining plans to construct its own wash plant and use existing rail facilities. The project is expected to provide about 764 jobs in direct employment during a 25-year mine life. Chinese miners experienced in longwall methods would start production but would be replaced within 10 years once Canadian miners are trained. Murray River awaits a final investment decision by HD Mining's parent company, China Huiyong Holdings.

Glencore Canada Corporation and JX Nippon Oil and Energy Corporation's **Sukunka** project has been planned as both an open-pit and underground operation. The project is listed on The British Columbia Environmental Assessment Office website as 'in progress'.

In July 2019, Conuma applied to the Environmental Assessment Office to open pit mine coal at the **Wolverine**-

Herman Amendment project, as a satellite to the Wolverine mine. If approved the Hermann pit would produce 1.5 to 3 Mt of coal per year and add up to 7 years to the life of the wash plant at the Wolverine mine.

5.3. North Central Region

There are four proposed mines in the North Central Region. Three are proposed metal mines and include, Taseko Mines Ltd.'s **Aley** Niobium project; New Gold Inc.'s **Blackwater** Au-Ag project and Centerra Gold Inc.'s Cu-Au-Ag **Kemess Underground** project. Graymont Western Canada Inc.'s **Giscome** project is a proposed industrial mineral mine (limestone).

5.3.1. Proposed metal mines

Taseko Mines Ltd.'s **Aley** project is a niobium-bearing carbonatite. Reserves stand at 84 Mt grading 0.5% Nb₂O₅. An open-pit mine is proposed, processing 10,000 tpd and producing ferroniobium. The projected mine life is 24 years with an output of about 9 Mkg of niobium annually, making it among the largest niobium deposits in the world. Environmental assessment is underway. In 2019, Taseko continued environmental monitoring and began product development and marketing initiatives. A pilot plant program was initiated to build on bench-scale niobium flotation and converter processes and to provide product samples for marketing.

New Gold Inc.'s **Blackwater** project has combined direct processing and low-grade Proven and Probable reserves of 344.4 Mt grading 0.74 g/t Au and 5.5 g/t Ag. As proposed, Blackwater would be a 60,000 tpd operation with a 17-year mine life. Once completed, the operation would consist of an open pit, an ore processing facility, a waste rock dump, a tailings pond, water management facilities, offices, employee accommodations, warehouses, and a truck shop. In 2019, New Gold received both provincial and federal Environmental Assessment Certificates but has not yet decided when to initiate the final mine permitting process as they re-evaluate project sizing and processing options.

Centerra Gold Inc.'s **Kemess Underground (KUG)** project is estimated to contain an Indicated resource of 246.4 Mt grading 0.22% Cu, 0.42 g/t Au, and 1.75 g/t Ag. Within this resource are Probable reserves of 107.4 Mt grading 0.27% Cu, 0.54 g/t Au, and 1.99 g/t Ag. The former Kemess South mine closed in 2011. However, infrastructure remains in place, and both the camp and ore processing plant will be used to service KUG, which is about 6.5 km north of the former processing plant. KUG is considered a stand-alone operation, to be mined by panel caving with crushed ore conveyed underground to the processing plant. Processing rate would be 24,600 tpd with a life of mine average production of 106,000 oz Au and 47 Mlbs Cu over a 12-year mine life. The KUG project has approval for development but Centerra is currently concentrating resources elsewhere.

5.3.2. Proposed industrial mineral mines or quarries

At their **Giscome** limestone project, Graymont Western Canada Inc. plans to exploit a high-purity Paleozoic limestone deposit. Crushed stone would be transported about 5 km by conveyor to lime kilns at a former stone quarry, owned and operated by CN Rail, in the community of Giscome. An existing CN Rail line would be used for transporting the product. The British Columbia Environmental Certificate for the project is in place, and the Mines Act Permit process is underway. The company anticipates starting construction in about 2020, with up to 600 Kt of limestone quarried annually.

5.4. South Central Region

Proposed mine projects in the South Central Region include KGHM Ajax Mining Inc.'s **Ajax**, Avino Silver and Gold Mines Ltd.'s **Bralorne**, Barkerville Gold Mines Ltd.'s **Cariboo Gold**, Taseko Mines Limited's **New Prosperity**, Ruddock Creek Mining Corporation's **Ruddock Creek**, Spanish Mountain Gold Ltd.'s **Spanish Mountain** and Taseko Mines Limited's **Yellowhead** projects. All are metal mine projects.

5.4.1. Proposed metal mines

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. 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.

In December, Talisker Resources Ltd. closed its acquisition of Bralorne Mines Ltd., a subsidiary of Avino Silver & Gold Mines Ltd. The cash and shares deal includes a payment of \$8.7 million. Avino acquired the Bralorne gold mine in 2014 and suspended mining shortly thereafter because the tailings storage facility reached capacity. Since then, Avino has carried out upgrades and plan to meet permitting requirements. In 2017, they received an updated permit for a 100 tpd throughput mining operation. Avino anticipates operating the mine at more than 100 tpd. However, they report that much of their existing infrastructure is inadequate for higher throughput and they are proceeding with re-development. The dam for tailings storage was raised in 2015 and the impoundment buttressed in 2016. A new water treatment plant was built in 2016, electrical systems upgraded, and retired equipment and buildings removed or demolished. Exploration on the property includes 28,000 m of drilling, which began in 2018 and extended through 2019.

The two-phase program included an underexplored area called the NorthEast block. Reporting gold-bearing veins in 27 of 35 holes, the company considers that the area has greater potential than previously recognized.

Barkerville Gold Mines Ltd. submitted a project description for the **Cariboo Gold** project to the British Columbia Environmental Assessment Office, which then issued a section 10 order requiring the project to obtain an Environmental Assessment Certificate to proceed. A 2019 preliminary economic assessment studied a 4000 tpd underground mine beneath Cow Mountain, Island Mountain, and the Valley zone in between. Reserves of 14.7 Mt at 4.5 g/t Au average diluted gold grade would give an expected 11-year mine life. Assuming a base-case gold price of US \$1325/oz and \$1.00=US\$0.77, the study estimated an internal rate of return of 28.1% and net present value of C\$402.2 million at a discount rate of 5%.

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 is ongoing with about 91,000 m drilling in 2019 at Cow Mountain (including newly discovered Lowhee zone), Island Mountain (Mosquito and Shaft zones), and Barkerville Mountain. In November of 2019, Osisko Gold Royalties Ltd. acquired all shares in Barkerville Gold Mines Ltd. they did not already own. The deal valued Barkerville at about \$338 million.

The New Prosperity project of Taseko Mines Limited, is a porphyry gold-copper deposit with Proven and Probable reserves of 830 Mt grading 0.42 g/t Au and 0.23% Cu. Taseko continues to seek a judicial review of the February 2014 federal decision to deny the project. British Columbia granted Taseko a project certificate in 2010 and extended its expiry date by five years to 2020. In 2017, the British Columbia Ministry of Energy, Mines and Petroleum Resources issued a permit for a detailed site investigation of proposed mine infrastructure. Most of the 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 the 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 the work.

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 (Imperial Metals Corporation 45.3%; Mitsui Mining and Smelting Co. Ltd. 30%; Itochu Corporation 20%; Japan Oil, Gas and Metals National Corporation 4.7%). JOGMEC funded the 2019 program. The joint venture operators followed up on positive 2018 results by drilling a total of 8800 m in 17 holes on the Q and V zones at the western edge of the massive sulphide prospect. A highlight from the deep V zone was 40.9 m grading 16.83% Zn, 3.46% Pb and 4.74 g/t Ag.

The **Spanish Mountain** project has Measured and Indicated resources of 273.2 Mt grading 0.47 g/t Au, 0.71 g/t Ag. Spanish Mountain Gold Ltd. proposes a phase one scenario whereby 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 project has been in the pre-application phase of environmental assessment since 2011. Current efforts are directed more toward optimization studies than environmental certification.

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 evaluating advancing it. A 2014 feasibility study considered a 70,000 tpd open-pit mine with a 28-year life, based on Proven and Probable reserves are 716.2 Mt at 0.26% Cu, 0.029 g/t Au and 1.18 g/t Ag.

5.5. Southeast Region

Proposed mine projects in the Southeast Region include NWP Coal Canada Ltd.'s **Crown Mountain** and North Coal Ltd.'s **Michel** coal projects. As well, there are two proposed industrial mineral mine projects: Eagle Graphite Corp.'s **Black Crystal** and MGX Minerals Inc.'s **Driftwood Creek** project.

5.5.1. Proposed coal mines

The **Crown Mountain** project is owned by NWP Coal Canada Ltd., 80% (a wholly owned subsidiary of Jameson Resources Ltd.) and Bathurst Resources Limited, 20%. Bathurst could become a 50/50 joint venture partner after exercising all tranches in the terms of an option agreement, with an investment totalling \$121.5M. The project contains seven major Mist Mountain Formation coal seams, with combined average thicknesses of 15 to 35 m. In 2014, the company completed a resource estimate of 74.9 Mt (Measured + Indicated).

In October 2014, the project advanced to the pre- application stage of environmental assessment and received application information requirements from the Environmental Assessment Office in April 2018. Results released in 2019 from coal quality test work indicate a premium hard coking coal in the north pit, and a low-volatile hard coking coal in the south pit. Coal quality test work indicates that approximately 84% of the coal is hard coking coal, the remainder PCI coal. Environmental baseline work and geotechnical drilling continued, as did engineering work on spoil pile design and water treatment, including the use of biological reduction of nitrate and selenium by naturally occurring microbes in waste piles. A feasibility study for the project is in progress and includes an open-pit mine with an estimated production capacity of 1.7 Mt per year of clean coal and a 16-year mine life.

In 2015, North Coal Ltd., a wholly owned subsidiary of CoalMont Pty Ltd., entered the pre-application phase of environmental assessment for their Michel Coal project. With subsequent expanded resource delineation and coal quality test work, the company amended their project proposal to include not only Loop Ridge, but also their Loop South, Tent Mountain, and Michel Head areas and, in September 2018, submitted a revised project description. The expanded plan will give them more flexibility in blending product from different areas to specification for clients. The project is expected to produce between 2.3 and 4 Mt annually, with a 30-year mine life. In 2019, work continued on their environmental baseline, permitting, and mine design. The project will use diversion, and active and passive techniques for managing waste rock and treating water to ensure that targets identified in the Elk Valley Water Quality Plan can be met. Drilling has identified 20 coal seams, between 5 and 20 m thick, and confirmed that coal is representative of typical Elk Valley hard coking coals (HCC). Structure and spacing of the seams give the project a low (ca. 6:1) strip ratio. In 2018, the company released an updated resource estimate with 44.6 Mt Measured and 42.5 Mt Indicated (open pit and underground) and is working towards an updated pre-feasibility engineering and design report.

5.5.2. Proposed industrial mineral mines or quarries

Eagle Graphite Corp. operates the **Black Crystal** flake graphite project. Graphite is in two identified zones: a 'hard rock' zone, and an overlying 'regolith' zone. The regolith zone is the near-surface weathered zone 2-4 m thick and has grades of up to 6.95% carbon. Most of the deposit is friable, and blasting is not required. Sand and aggregate would be by-products during the mining and refining process. In 2019, the company continued research into processing techniques and received a \$290,000 grant from CleanBC towards advancing lithium-ion graphite.

The **Driftwood Creek** project is owned by MGX Minerals Inc. The deposit is 100 to 300 m wide to a depth of approximately 110 m, and has been traced along strike for 2000 m. In 2018, the company released a preliminary economic assessment for a 1200 tpd quarry operation. The mine would produce 169,700 t of MgO at an average grade of 43.27% MgO, with a 19-year mine life, and 2.4:1 strip ratio. In 2019, the company continued environmental baseline studies and obtained permits for additional infill drilling.

5.6. Southwest Region

Proposed quarries in the Southwest Region include Polaris Materials Corporation's **Black Bear**, BURNCO Aggregate's **BURNCO Aggregate** and Ballinteer Management Inc.'s **Sechelt Carbonate** projects.

5.6.1. Proposed quarries

Polaris Materials Corporation is including 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 250,000 tpy of crushed basalt.

The **BURNCO Aggregate** project now has environmental certification and may proceed with British Columbia Mines Act and other permitting. The proposed sand and gravel mine would ramp up to a 1.6 Mtpy 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.

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 2017-2019. The property contains resources of calcite- and dolomite-bearing carbonate rock and gabbroic rock for potential use as aggregate.

6. Exploration expenditures

In 2019, exploration expenditures, drilling estimates, and other metrics for British Columbia were captured in the British Columbia Mineral and Coal Exploration Survey. The survey is a joint initiative between the Province of British Columbia Ministry of Energy, Mines and Petroleum Resources, the Association for Mineral Exploration, and EY LLP. A full report will be available in March. The new survey does not capture exploration expenditures for aggregates, which had previously been done for the Southwest region only.

Total metal, industrial mineral and coal exploration expenditures are estimated at 329.5 million for 2019, down \$1.9 million from the 2018 survey total of \$331.4 million. Of this, \$40.8 million was from coal projects and \$288.7 million was from metal and industrial mineral projects (Fig. 5). Exploration expenditures by region (Fig. 6) can be further divided into five categories: grassroots, early stage, advanced stage, mine evaluation, and mine lease (Figs. 7, 8). The provincial combined total for grassroots and early-stage exploration in the 2019 survey is 39.8%, down from the 2018 total of 44.4%.



Fig. 5. Exploration expenditures per year, by type.



Fig. 6. 2019 exploration expenditures by region.



Fig. 7. 2019 exploration expenditures by category.

The total reported metres drilled for the province was 709,734, down from the 2018 total of 730,500 (see Fig. 9 for regional breakdown).

7. Exploration land tenure

Acquisition of new mineral claims in 2019 was down slightly compared to 2018 (Fig. 10). The total for 2019 was 1,913,583 hectares vs. 1,961,719 hectares for the previous year. New coal licences issued in 2019 totalled 9045 hectares, up slightly from the 2018 total of 8852 hectares (Fig. 11).

8. Summary of assessment work, 2018

Results of mineral exploration programs are submitted by industry in assessment reports to the government in compliance with the Mineral Tenure Act. After a one-year confidentiality period, the reports become an open resource for mineral exploration, investment, research, land use, and resource management. The British Columbia Geological Survey maintains these reports in the Assessment Report Indexing System (ARIS) database. This database provides information about the location, mineral occurrences, commodities, claims, work types, and expenditures as presented in the assessment reports. ARIS contains more than 37,600 reports dating from 1947, and describes work valued at more than \$2.8 billion. All reports are available online as PDF documents through the British Columbia Geological Survey website.

The present summary includes assessment work registered with a Statement of Work affidavit date to the end of 2018 and

does not include work that may have been conducted in 2018 but registered in 2019. The expenditures recorded in assessment reports are registered to maintain claims beyond their expiry date and thus reported costs represent only a portion of the total amount spent.

The number of approved assessment reports with an affidavit date of 2018 totalled 714 (Fig. 12), with declared costs of \$112,528,518.38 (Fig. 13), a 22% increase in expenditures from 2017 (Table 7). The Northwest Region accounted for 52% of the province-wide exploration costs in 2018 (Fig. 14). The region registered \$59 million in exploration expenditure in 2018, a 25% increase from 2017 (\$47.2 million) and more than double 2015 levels (\$25.6 million). Drilling accounted for 66% of the expenditures, geochemical sampling 15%, geophysical surveys 11%, geological mapping 6%, prospecting 1%, and physical work 1% (Fig. 15). Average exploration costs by work type (Table 8) are from report statements for labour, consulting, food, accommodation, transport, camp equipment rentals and supplies, laboratory analyses, report preparation, direct administration, and project management.

In addition to data about exploration work and expenditures, the ARIS database contains information about commodities. The commodities that showed the most growth between 2016 and 2018 were silica (as frac sand or industrial use silica), platinum, palladium, cobalt, and vanadium (Table 9).

Traditionally, data in assessment reports have been embedded in paper or non-digital electronic files, such as .PDF, making then difficult to extract and use. To resolve this problem, the British Columbia Geological Survey has embarked on a program to encourage submission of digital data files such as spreadsheets, databases, maps, and grids, which can be easily retrieved, integrated, recalculated, and recast for specific needs. These files can be uploaded through the ARIS Data Submission page (http://ardata.bcgeologicalsurvey.ca), submitted by CD/ DVD/USB when an assessment report is filed, or e-mailed to ARIS.digital@gov.bc.ca.

9. Selected exploration project highlights

After two years of recorded increases in exploration expenditures, there was a decrease of \$1.9 million in 2019. Explorationists however, continued to discover, define, and expand porphyry and porphyry-related copper-gold and copper-molybdenum deposits, gold deposits of various types, and stratiform base-metal, specialty metals, industrial minerals, and coal deposits. Data from the British Columbia Mineral and Coal Exploration Survey show a slight decrease in grassroots and early-stage projects (combined). Below, selected exploration projects (Fig. 1; Table 10) are grouped by project type and region; the individual regional sections of this volume provide further details.

9.1. Selected precious metal projects

9.1.1. Northwest Region

Brixton Metals Corp.'s Atlin Gold project includes a 933 km² area near Atlin. Mesothermal-style mineralization





Fig. 9. 2019 exploration drilling by region.



Fig. 10. New mineral claims by year.



Fig. 11. New coal licence issuances by year.

is structurally controlled, and new geophysical data from vertical-gradient magnetic surveys highlight several structures that could potentially control gold mineralization. Exploration work in 2019 included 1618 m of drilling in 22 holes at the Pictou and LD showings, a 1965 line-km magnetic geophysical survey, and soil and rock sampling. Results from drilling included gold mineralization in 13 of 22 holes, where highlights were 8.53 g/t Au across 2 m. A rock grab sample from Union Mountain returned 45 g/t Au.

Margaux Resources Ltd. and Wildsky Resources Inc. entered into an agreement for Margaux Resources to acquire 100% interest in the **Cassiar Gold** project early in 2019. Historic gold production on the property was approximately 350,000 oz at an average grade of 11.9 g/t Au, and about 275,000 m of



Fig. 12. Assessment reports approved between 2004 and 2018 by work affidavit date.







Fig. 14. Expenditures approved for assessment credit between 2004 and 2018 by work affidavit year and region.

		Reports	Value	Core	drilling	Non• dril	-core ling	Stream sediment	Rock	Soil
			\$	Holes	m	Holes	m	Samples	Samples	Samples
Northwest	2018	193	\$59,027,865	450	128,179	27	1717	19,377	1072	11,566
North Central and Northeast	2018	97	\$23,517,701	95	43,727	8	602	6623	84	1655
South Central	2018	222	\$16,858,908	145	45,792	65	1,041	14,882	495	3095
Southeast	2018	120	\$9,348,942	154	25,071	-	-	4936	172	2087
Southwest	2018	82	\$3,775,102	25	3715	12	306	3918	170	1359
Provincial total	2015	655	\$62,719,690	682	158,006	95	520	26,782	1827	10,770
Provincial total	2016	618	\$85,141,604	465	165,212	14	250	34,715	777	9698
Provincial total	2017	722	\$92,215,514	1199	205,434	173	3458	30,188	1450	14,648
Provincial total	2018	714	\$112,528,518	869	246,484	112	3665	49,736	1993	19,762

Table 7. Summary of assessment work, 2018.



Fig. 15. Proportion of value of exploration by work type in the work affidavit year 2018.

Table 8. Average exploration project costs, 201	ole 8. Average ex	cploration	project	costs,	2018
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historical drilling was conducted on the property. Orogenicstyle mineralization is found predominantly in basalt-hosted low-sulphide gold-bearing shear veins intimately related to regional faults. Shear veins are generally steeply dipping and <2 m wide, but widths range from a few cm to about 10 m. In September 2019, after a review of historical data, Margaux announced an updated Inferred resource estimate for the Taurus deposit at 21.83 Mt grading 1.43 g/t Au with a 0.7 g/t Au cut-off. The company is compiling and analyzing data and furthering its economic assessment with more field work.

In November, Sky Gold Corp. dropped the option for the **Clone Gold** project, and Teuton Resources Corp. now owns 75% interest, with Silver Grail Resources Ltd. owning the remaining 25%. The property is 20 km southeast of Stewart and contains gold and gold-copper mineralization in a series

	Cost	2015	2016	2017	2018	
Core drilling	\$ per m	219	310	252	297	
Non-core drilling	\$ per m	631	611	284	361	
Stream sediments	\$ per sample	200	332	355	348	
Soil samples	\$ per sample	148	139	152	152	
Rock samples	\$ per sample	260	269	371	371	
Trenching	\$ per m	91	92	163	78	
Ground EM	\$ per km	1306	1419	3700	2187	
Ground magnetics	\$ per km	739	1182	906	807	
Induced polarization	\$ per km	5339	7882	4879	8362	
Airborne magnetics	\$ per km	59	48	40	91	
Airborne EM	\$ per km	293	177	126	83	
Geological mapping	\$ per ha	41	70	59	16	
Prospecting	\$ per ha	19	51	19	9	

	Reports filed 2016	Reports filed 2017	% change 2016-17	Reports filed 2018	% change 2017-18
Gold	1113	1375	24%	1109	-19%
Copper	833	1055	27%	851	-19%
Silver	692	847	22%	817	-4%
Zinc	358	537	50%	439	-18%
Lead	311	424	36%	356	-16%
Molybdenum	239	277	16%	218	-21%
Cobalt	15	45	200%	86	91%
Nickel	30	60	100%	63	5%
Silica/frac sand	3	8	167%	39	388%
Platinum	20	28	40%	36	29%
Palladium	19	21	11%	31	48%
Iron	25	19	-24%	22	16%
Limestone	27	11	-59%	20	82%
Tungsten	37	49	32%	20	-59%
Vanadium	0	0	-	19	-

 Table 9. Most commonly explored for commodities.

Table 10. Selected exploration projects.

Project	Region	Operator (partner)	Commodity; Deposit type MINFILE	Resource (NI 43-101 compliant unless indicated otherwise)	Comments
Atlin Gold	Northwest	Brixton Metals Corporation	Au; Hydrothermal precious metal veins; 104N 043	na	1695 line-km magnetic survey; 1618 m of drilling with highlights of 8.53 g/t Au across 2 m and a grab sample returned 45 g/t Au.
Ball Creek	Northwest	Golden Ridge Resources Ltd. (80%), Evrim Resources Corp. (20%)	Cu, Au; Porphyry; 104G 072	na	Soil sampling, geological mapping, and prospecting identified new mineralized targets. 1095 m of deep diamond drilling to test the southwest extension of Main zone; drilling at Goat zone. Highlights at Main zone: 291.5 m at 0.14% Cu, 0.48 g/t Au, and 0.95 g/t Ag.
Brucejack Regional	Northwest	Pretium Resources Inc.	Au, Cu, Pb, Zn; Epithermal vein and VMS	na	15,000 m of drilling at regional Brucejack prospects. Regional grassroots sampling, mapping, prospecting, geophysics, and hyperspectral mapping. Drill highlights from the A6 zone included 1.5 m grading 2890 g/t Ag and 1.81% Cu.
Cassiar Gold	Northwest	Margaux Resources Ltd.	Au; Precious metal veins; 104P 012	Inf: 21.83 Mt at 1.43 g/t Au (0.7 g/t Au cut-off)	Compilation and data analysis.
Castle	Northwest	Colorado Resources Ltd.	Cu, Au, Ag; Porphyry and precious metal veins	na	Coincident gold and copper anomalies from sampling chargeability anomalies over East Castle zone; 1555 m drilling as follow up.

Clone Gold	Northwest	Teuton Resources Corp. (75%), Silver Grail Resources Ltd. (25%)	Ag, Zn, Pb; Polymetallic; 104A 176	na	In November, Sky Gold Corp. dropped the option for Clone Gold; Teuton Resources Inc. now owns 75% interest and Silver Grail Resources owns 25%. Drilling of 811 m to confirm historical results and test new areas. Highlights of 124.6 g/t Au across 4.1 m in the Main "H" zone.
Dolly Varden	Northwest	Dolly Varden Silver Corporation	Cu, Pb, Zn, Ag, Au; Kuroko VMS with polymetallic veins; 103P 188	I: 3.42 Mt at 299.8 g/t Ag Inf: 1.29 Mt at 277.0 g/t Ag	Preliminary metallurgical testing, 11,000 m of drilling, geochemical sampling, prospecting and geological mapping. Highlights at Chance target of 15.20 m grading 488.3 g/t Ag, 0.55% Pb, and 0.05% Zn in a previously unknown offset of the Chance vein.
Engineer	Northwest	Engineer Gold Mines Ltd.	Au, Ag; LS-epithermal; 104M 014	Inf: 41,000 t at 19.0 g/t Au	3000 m of surface and underground drilling. Historic channel sample highlights from the Double Decker vein returned 38.03 g/t Au across 24.7 m.
Eskay Creek	Northwest	Skeena Resources Limited	Au, Ag, Cu, Pb, Zn; VMS and precious metal veins; 104B 008	I: 12.65 Mt at 4.3 g/t Au, 110 g/t Ag (pit constrained) Inf: 14.42 Mt at 2.3 g/t Au, 47 g/t Ag (pit constrained) I: 819,000 t at 6.4 g/t Au, 139 g/t Ag (underground) Inf: 295,000 t at 7.1 g/t Au, 82 g/t Ag (underground)	Drilling in 2019 focussed on upgrading areas of Inferred resources into Indicated category; highlights include 312.81 g/t Au and 95 g/t Ag across 2.21 m, and separately 6.75 g/t Au and 285 g/t Ag across 27.50 m.
Forest Kerr	Northwest	Aben Resources Ltd.	Au, Ag, Cu; Precious metal veins	na	9600 m drilled in 25 holes; highlights include a 16 m interval grading 2.22 g/t Au, 2.39 Ag, and 0.31% Cu.
Golddigger	Northwest	Goliath Resources Limited	Au, Cu, Pb, Zn; Polymetallic veins	na	Field reconnaissance to followup targets generated via lidar and geochemical sampling. Most chip samples (30) from Sure Bet zone returned assays >1.4 g/t Au. A single channel sample was assayed at 8.4 m of 7.37 g/t Au, including 3.4 m of 17.68 g/t Au.
Hank	Northwest	Golden Ridge Resources Ltd.	Cu, Au; Calc-alkaline porphyry	na	2952 m of drilling with highlights at the Williams zone including 278 m grading 0.35% Cu, 0.28 g/t Au, and 1.71 g/t Ag.

Nickel Mountain	Northwest	Garibaldi Resources Corp.	Ni, Cu, Co, Pt, Pd, Au; Tholeiitic intrusion hosted; 104B 006	na	25,000 m of drilling; highlights include 18.2 m grading 7.04% Ni and 3.81% Cu in a broader zone of mineralization of 86.5 m grading 1.88% Ni and 1.32% Cu.
Premier/Dilworth	Northwest	Ascot Resources Ltd.	Au, Ag, Cu; LS-epithermal, polymetallic veins; 104B 054	I: 2.78 Mt at 7.46 g/t Au and 26.2 g/t Ag (Premier, Northern Lights, Big Missouri, Silver Coin, and Martha Ellen deposits)	>50,000 m of drilling; highlights included 24.45 g/t Au across 8.43 m.
Rock and Roll	Northwest	Etruscus Resources Corp.	Cu, Zn, Pb, Au; Besshi VMS and intrusion-related precious metal veins; 104B 377	Inf: 2.02 Mt at 0.71 g//t Au, 87.1 g/t Ag, 0.23% Cu, 0.23% Pb, 0.98% Zn	Biogeochemical orientation survey for Au, Ag, Ba, Cu, Fe, Hg, Pb, Se, Zn in tree bark samples; 2500 m of diamond drilling.
Schaft Creek	Northwest	Teck Resources Limited (75%) , (Copper Fox Metals Inc. (25%)	Cu, Mo, Au, Ag; Porphyry; 104G 015	M+I: 1.23 Bt at 0.26% Cu, 0.017% Mo, 0.19 g/t Au, 1.69 g/t Ag Inf: 597.2 Mt at 0.22% Cu, 0.016% Mo, 0.17 g/t Au, 1.65 g/t Ag	Continued environmental studies and infrastructure work.
Scottie Gold Mine	Northwest	Scottie Resources Corp.	Au, Ag, Cu: Intrusion-related and polymetallic veins; 104B 034	na	Geochemical surface sampling and 2050 m of drilling on Bow property. Drilling in areas recently exposed from glacier retreat. A grab sample at the Domino zone produced 536 g/t Au and 735 g/t Ag.
Silver Coin	Northwest	Ascot Resources Ltd.	Au, Ag, Cu, Zn, Pb; LS-epithermal and polymetallic veins; 104B 095	I: 0.70 Mt at 4.46 g/t Au and 17.9 g/t Ag Inf: 0.97 Mt at 4.39 g/t Au and 19.0 g/t Ag	10,500 m of drilling; highlights include 52.67 g/t Au across 3.59 m.
Silver Queen	Northwest	Equity Metals Corporation	Ag, Pb, Zn, Au; Transitional porphyry- epithermal; 093L 002	I: 0.815 Mt at 6.35% Zn, 3.24 g/t Au, 201.4 g/t Ag, 0.26% Cu, 0.96% Pb Inf: 0.801 Mt at 5.21% Zn, 2.49 g/t Au, 184.3 g/t Ag, 0.31% Cu, 0.88% Pb (resources at NSR cut-off of C\$100/t)	New Nadina Explorations changed its name to Equity Metals Corp. In August, a mineral resource estimate was released.
Snip	Northwest	Skeena Resources Limited	Au, Ag; Intrusion-related, mesothermal; 104B 250	na	Surface drilling in 10 holes totalling 1934 m; highlight of 1131.91 g/t Au across 1.5 m.

Table 10. Continued	•				
Tatogga (Saddle North)	Northwest	GT Gold Corp.	Cu, Au, Ag; Porphyry; 104G 432	na	Continued to expand mineralization to depth and along trend. Recent drilling has also identified high-grade precious metal veins peripheral to the main body of porphyry mineralization including highlights of 4.11 m of 25.42 g/t Au and 15.70 m of 6.21 g/t Au. Newmont Corporation invested \$25.9M. Resource estimate and economic evaluation expected first quarter, 2020.
Thorn	Northwest	Brixton Metals Corporation	Ag, Au, Cu, Zn, Pb; Subvolcanic; 104K 031	I: 7.4 Mt at 35.54 g/t Ag, 0.51 g/t Au, 0.13% Cu, 0.32% Pb, 0.59% Zn	Geological mapping and soil- rock geochemistry at the Chivas zone. An induced polarization- magnetotelluric survey showing a chargeability high over Oban zone. Drill highlights at Oban zone returned 554 m of 0.57 g/t Au, 0.24% Cu, 43 g/t Ag, 0.55% Zn, and 0.28% Pb.
Treaty Creek	Northwest	Tudor Gold Corp. (80%), (Teuton Resources Corp. (20%), American Creek Resources Ltd. (20%))	Cu, Au; Porphyry; 104A 004	na	Drilling at the Goldstorm zone, totalling 9780 m in 14 diamond drill holes, returned highlights of 2.006 g/t Au across 87 m, in an interval of 336 m averaging 1.004 g/t Au.
Turnagain	Northwest	Giga Metals Corp.	Ni, Co, Pt, Cu, Mo; Alaskan-type, magmatic; 104I 014	M+I: 1.073 Bt at 0.220% Ni and 0.013% Co Inf: 1.142 Bt at 0.217% Ni and 0.013% Co	Updated resource in September 2019 based on 36 infill holes totalling 8940 m drilled in 2018. A preliminary economic assessment (PEA) is expected in 2020.
Willoughby	Northwest	Strikepoint Gold Inc.	Au, Ag, Zn, Pb; Precious and polymetallic veins; 103P 006	na	Hand-trenching and channel sampling; 2000 m of diamond drilling. North zone highlights of 26.28 g/t Au and 95.00 g/t Ag across 4.0 m; surface sampling near the Wilkie zone returned a grab sample of 67.3 g/t Au and 164.0 g/t Ag.
Akie	North Central	ZincX Resources Corp.	Zn, Pb, Ag; Sedimentary exhalative Zn-Pb-Ag; 094F 031	I: 22.7 Mt at 8.32% Zn, 1.81% Pb, 14.1 g/t Ag Inf: 7.5 Mt at 7.04% Zn, 1.24% Pb, 12.0 g/t Ag (at 5% Zn cut-off)	PEA proposed 18-year mine life, mine production rate 4000 tpd, 25.8 Mt total mined, initial capital cost \$302.3 million. In 2019, four DDH holes, 2347 m. Results included 10.94 m (true width) of 10.85% Zn, 2.23% Pb and 17.0 g/t Ag and 14.65 m (true width) of 16.20% Zn, 3.39% Pb and 27 g/t Ag.
Atty	North Central	Serengeti Resources Inc.	Cu, Mo, Au; Porphyry Cu±Mo±Au	na	Geophysics, 29.8 line-km IP. Drilling six DDH, 2318 m. Results included 87.7 m of 0.04% Cu, 0.14 g/t Au and 0.4 g/t Ag.

Chuchi	North Central	Centerra Gold Inc.	Cu, Au; Alkalic porphyry Cu- Au; 093N 159	I: historic non-NI 43-101 compliant: 50 Mt at 0.21-4.0% Cu, 0.21-0.44 g/t Au (Digger Resources Inc., 1991)	Geophysics, 731 line-km low altitude aeromagnetic survey. Drilling four DDH, 1755 m.
Decar	North Central	FPX Nickel Corp.	Ni; Ultramafic-hosted 093K 039, 72, 89	I: 1843 Mt at 0.143 DTR (Davis tube recoverable) Ni Inf: 391 Mt at 0.115% DTR Ni, at 0.06% cut-off	Bench-scale metallurgical testing produced clean nickel concentrates grading 63 to 65% Ni with improvements in recovery relative to previous testing. By-product iron ore concentrates graded 60 to 65% cent Fe.
Indy	North Central	InZinc Mining Ltd.	Zn, Pb, Ag; Sedimentary exhalative Pb-Zn-Ag 093N 240	na	Soil surveys (1194 samples), mapping and prospecting.
Kemess East	North Central	Centerra Gold Inc.	Cu, Mo, Au; Porphyry Cu±Mo±Au; 094E 315	I: 113.12 Mt at 0.38% Cu, 0.46 g/t Au, 1.94 g/t Ag, containing 954 Mlb Cu, 1680 Koz Au, 7066 Koz Ag	Potential to be integrated into the Kemess Underground project.
Kwanika	North Central	Kwanika Copper Corp. (65% Serengeti Resources Inc., 35% Posco International Corporation)	Cu, Au, Ag; Porphyry Cu±Mo±Au; 093N 073	I: Central zone pit: 11.8 Mt at 0.37% Cu, 0.39 g/t Au, 1.07 g/t Ag. Central zone underground: 41.4 Mt at 0.46% Cu, 0.52 g/t Au, 1.36 g/t Ag	Working on an interim study report.
Lawyers	North Central	Benchmark Metals Inc.	Au, Ag, Cu, Zn; Epithermal Au-Ag-Cu, low sulphidation; 094E 066	Inf: Cliff Creek N zone, 550 Kt at 4.51 g/t Au, 209.15 g/t Ag Duke's Ridge Zone, 58 Kt at 4.30 g/t Au, 139.13 g/t Ag	Drilling, 47 DDH, 11,000 m. Results included 4.4 m grading 11.73 g/t Au and 476 g/t Ag at the Cliff Creek zone, 25.0 m grading 2.79 g/t Au and 177 g/t Ag, and 2.95 m grading 30.2 g/t Au and 1361 g/t Ag at the AGB zone, 2.87 m grading 46.9 g/t Au and 3056 g/t Ag at the Phoenix zone and 3.34 m grading 7.85 g/t Au and 830 g/t Ag at the Duke's Ridge zone.
Mt. Milligan on- lease (brownfield) and off-lease (greenfield)	North Central	Centerra Gold Inc.	Cu, Au, Ag; Alkalic porphyry Cu- Au; 094N 194, 093N 091	na	Geophysics, 640 line-km low altitude aeromagnetic survey, planned 32 line-km IP. Drilling near pit (planned) 25,000 m. Drilling outside ultimate pit, 23 holes, 9900 m.

Stardust	North Central	Sun Metals Corp.	Ag, Pb, Zn; Skarn Ag-Pb-Zn; P93N 009	na	Drilling, estimated 27 holes, 15,000 m. Results included 24.85 m of 3.13% Cu, 4.8 g/t Au, and 93.45 g/t Ag, and 58.01 m of 2.49% Cu, 2.61 g/t Au, and 44.3 g/t Ag.
Wicheeda	North Central	Defense Metals Corp.	Carbonatite-hosted deposits; Nb, REE; 093J 014	Inf: 11.37 Mt 1.14% Ce, 0.53% La, 0.23% Nd, 0.04% Nb, 0.01% Sm and 1.96% LREE (at a 1% LREE cut-off)	Collected 30 t bulk sample. Drilling, 13 holes, 2005 m. Results included 83 m of 4.43% light rare earth oxides (LREO) and 58 m of 4.01% LREO.
17-001, 002, 003	Northeast	Sil Industrial Minerals Ltd.	Sand and gravel (as frac sand)	na	Drill sampling, 90 holes, 600 m.
Huguenot	Northeast	Colonial Coal International Corp.	Coal; Bituminous	M+I: 132.0 Mt (in situ surface mineable)	Released a Preliminary Economic Assessment.
Amarillo	South Central	Troubadour Resources Inc.	Cu; L04: Porphyry Cu±Mo±Au; 082ENW108	na	Mapping, sampling, drilling 1075 m in 4 holes
Lac La Hache	South Central	Engold Mines Ltd.	Cu, Au, Ag, Fe; L03: Alkalic porphyry Cu-Au, K01: Cu skarn; 092P 120, 108, 2	I: 7.60 Mt 0.28% Cu, 0.05 g/t, 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 Inf: 1.073 Mt 2.48 g/t Au, 0.64% Cu, 5.98 g/t Ag (Aurizon)	Diamond drilling (1276 m, 9 holes), soil sampling. Highlight 6.18 g/t Au, 0.80% Cu and 2.63 g/t Ag across 4.55 m.
Merit	South Central	Independence Gold Corp.	Au, Ag; H05: Epithermal Au- Ag; 092ISW106	na	Prospecting, rock sampling, ground magnetic survey, metallurgy. Sample highlight 9.5 g/t Au and 341 g/t Ag.
Miner Mountain	South Central	Sego Resources Inc.	Cu, Au; L03: Alkalic porphyry Cu-Au; 092HSE203, 78	na	Trenching results reported early in the year included 18 m grading 0.96% Cu and 0.31 g/t Au. New drill targets identified.
Mont	South Central	Leo Lindinger	Bentonite; E06: Bentonite	na	3 drill holes-all intersected bentonite clay.
MPD	South Central	Dunnedin Ventures Inc.	Cu, Au; L03: Alkalic porphyry Cu-Au; 092HNE243, 55, 191, 244	na	1766 m diamond drilling in 3 holes. Surface trench sample 0.89% Cu across 46 m.
New Craigmont	South Central	Nicola Mining Inc.	Cu, Au; Cu skarns; 092ISE035	na	Results of 2018 drilling released, additional drilling 2019. Highlights 84 m 0.34% Cu, 44 m 0.45% Cu, 13 m 0.65% Cu with magnetite. Soil geochemistry, mapping.

Olivine Mountain	South Central	GSP Resources Corp.	Cu, Au, Pd; M05: Alaskan type; 092HNE201, 092HSE095, 141, 39	na	Approx. 1200 m in 7 holes.
Shovelnose	South Central	Westhaven Ventures Inc.	Au; H05: Epithermal Au-Ag-Cu low sulphidation; 092HNE309, 308	na	Approx. 20,000 m in 50 holes. Third vein zone intersected in South zone. New targets identified in regional prospecting, ground magnetic, soil, and resistivity surveys.
Spences Bridge	South Central	Talisker Resources Ltd.	Au, Ag; H05: Epithermal Au-Ag-Cu low sulphidation; 092O 054, 60, 143, 092INW092, 110, 092ISW118, 124, 84	na	Regional stream-sediment survey, prospecting.
Spius	South Central	Pacific Ridge Exploration Ltd.	Cu, Mo; L04: Porphyry Cu±Mo±Au; 092HNW027	na	Diamond drilling 1087 m in 4 holes.
Duncan	Southeast	Rokmaster Resources Ltd.	Zn-Pb-Ag; Carbonate-hosted; 082KSE023, 22	na	Mapping; sampling; soil geochemistry; historic drill core results include 7.5 m grading 6.2% Zn + 6.3% Pb, 4.8 m grading 11.4% Zn + 0.8% Pb, and 6.9 m grading 7.1% Zn + 4.6% Pb.
Elko	Southeast	Pacific American Coal Limited	Coal (HCC, PCI); 082GSE029	M: 117.6 Mt I: 93.2 Mt Inf: 92.3 Mt (JORC 2019)	Drilling (8 RC, 1 large-diameter core; 3451 m); environmental baseline studies and permitting; mapping of five coal seams; 3 seams have hard coking coal quality, 2 seams have PCI coal.
Gibraltar	Southeast	MGX Minerals Inc.	Si; Silica sandstone; 082JSW001	na	Drilling (5 DD holes, 200 m); metallurgical test work results indicated suitability for medium quality feedstock for metallurgical-grade silicon; sampled 97.8 to 99.9% SiO ₂ .
Gold Drop	Southeast	GGX Gold Corp.	Au; Alkaline intrusion associated Au; 082ESE055, 150, 152, 153, 285, 286, 287	na	Drilling (48 DD holes, 2284 m on C.O.D. vein; 10 DD holes, 685 m on North C.O.D. vein); rock sampling; trenching; channel sampling; airborne audio magnetotelluric survey.
LH	Southeast	Magnum Goldcorp Inc.	Cu-Ag-Au; Subvolcanic, skarn, Au-veins; 082FNW212	na	Drilling (4 DD holes, 250 m); results included 5.58 m grading 4.068 g/t Au, including 0.27 m grading 22.8 g/t Au.
Ore Hill	Southeast	Apex Resources Inc.	Au+/-Ag, Pb, Zn; Au-quartz veins, polymetallic veins; 082FSW040, 48, 50, 51, 52, 53, 082FSE030, 31, 34, 25	na	Data compilation, mapping, rock sampling; 2 magnetic anomalies coincident with soil geochemical anomalies and historic production; drilling (600 m DD program) late in the year; visible gold in drill core.

Provincial Overview of Exploration and Mining in British Columbia, 2019. British Columbia Geological Survey, Information Circular 2020-01
Regal	Southeast	Affinity Metals Corp.	Ag-Pb-Zn+/-Au; Polymetallic veins, SEDEX; 082N 004, 3, 16	Regal : 590,703 t grading 71.6 g/t Ag, 2.66% Pb, 1.26% Zn, 1.1% Cu, 0.13% Sn, 0.015% W (1982; non-compliant)	Drilling (1846 m; Regal: 10 DD holes, Allco : 11 DD holes); data compilation; 2011 ZTEM airborne geophysical survey; grab sampling (22 samples at Allco) with results up to 4420 g/t Ag, 2.27% Cu, 26.4% Zn, >20% Pb, and 5.68 g/t Au.
Sweet Spot	Southeast	Teck Resources Ltd.	Pb-Zn-Ag+/-Au; Polymetallic vein, SEDEX; 082GSW077	na	Drilling (2 DD holes, 1371 m); mapping; sampling; re-logging historic core; petrophysics; short wave near infrared spectral analysis; initial stages of exploration identified fragmental units, alteration assemblages, and indicators of SEDEX mineralization.
Brandywine	Southwest	Bayhorse Silver Inc.	Ag, Au, Pb, Zn; I05: Polymetallic veins; 092JW 001, 21, 22	na	Core reanalysis. Metallic screen assays up to 20.2 g/t Au across 1.5 m.
Gold Standard	Southwest	DSM Syndicate Holdings Ltd.	Au, Ag; I01: Au quartz veins, reported VMS target	na	Mapping, rock sampling. Highlight 5.81 g/t Au across 12 m.
Margurete	Southwest	Academy Metals Inc.	Au, Ag; I01: Au quartz veins; 092K 025, 151, 187, 30, 20	na	Rock sampling, backpack drilling. Highlight 8.62 g/t Au over 0.38 m, 6.18 g/t Au across 2 m.
Peneece	Southwest	Delrey Metals Corp.	Magnetite, Ti, V; M05: Alaskan type; 092M 010, 1	na	Airborne magnetic survey. Deposit type is speculative.
Surespan Gold	Southwest	Privateer Gold Ltd.	Au, Ag; Au-quartz veins; 092L 008, 311, 155	Historical: 122,470 t at 9.26 g/t Au and 324,772 t at 15.09 g/t Au	Drilling 4400 m in 18 holes.
Teeta Creek	Southwest	ArcWest Exploration Inc.	Cu, Mo, Au; L04: Porphyry	na	Mapping, prospecting, rock sampling. Highlight 21.1 g/t Au. Teck Resources Limited has entered into an agreement to explore the property to earn an initial 60%.

Table 10. Continued.

M = Measured; I = Indicated; Inf = Inferred

of sub-parallel shears along a 500 m strike length. In 2019, before dropping the option, Sky Gold drilled 811 m, which was designed to confirm historical results and test new areas. Drill highlights included 124.6 g/t Au across 4.1 m in the Main "H" zone, which has known mineralization extending along a 300 m strike length.

Centred on the historic Engineer Gold mine the 14,020 ha **Engineer** project is 32 km southwest of Atlin. Dewatering of existing underground workings was completed in 2019, which will provide exploration access to Shear zone A, Jersey Lilly, Double Decker, and Engineer veins on one of the mine levels.

Dewatering will also allow for test mining and bulk sampling. A 3000 m surface and underground drill program was conducted, targeting near-mine veins and bulk-tonnage shear and intrusive-hosted gold targets. Historic channel sample highlights from the Double Decker vein returned 38.03 g/t Au across 24.7 m.

Since 2016, the Boundary zone has been the focus of Aben Resources at the **Forrest Kerr** project. Earlier this year an airborne magnetic survey was completed over the entire Boundary zone to delineate the subsurface geology and put into context high-grade gold mineralization discovered previously (2018 drill highlights of 62.4 g/t Au across 6.0 m). In 2019, 9600 m of core drilled in 25 drill holes focussed on testing the North Boundary zone and encountered precious and polymetallic mineralization in shear zones cutting Hazelton Group volcanic and subvolcanic rocks and spatially coincident with magnetic anomalies. Drill highlights included a 16 m interval grading 2.22 g/t Au, 2.39 Ag, and 0.31% Cu.

Approximately 20 km north-northeast of Stewart, the Premier project is Ascot Resource's flagship operation. About 628,000 m of previous drilling primarily targeted the Premier mine, the Big Missouri mine, Martha Ellen, and the Dilworth zones. Drilling in 2019 was designed to test exploration targets delineated from geophysical work in 2018 and to upgrade and expand resources in known zones of mineralization. By the end of the year more than 52,000 m of drilling was completed; a highlight included 24.45 g/t Au across 8.43 m. Precious metal mineralization in the area is thought to have been magmatically derived and is spatially associated with the Texas Creek plutonic suite. Mineralized quartz-calcite veins, vein stockwork, and hydrothermal breccia systems cut volcanic and sedimentary rocks of the Hazelton Group. The Premier, Northern Lights, Big Missouri, Silver Coin, and Martha Ellen deposits contain an Indicated resource of 2.78 Mt grading 7.46 g/t Au and 26.2 g/t Ag.

The **Snip** mine produced approximately 1 Moz of gold from 1991 to 1999. Skeena Resources Limited acquired 100% interest in the project from Barrick Gold in 2017. Late in 2018, Skeena optioned the property and received an investment from Hochschild Mining Holdings Ltd, where nearly \$7 million was generated giving Hochschild 8.3% of Skeena's total issued and outstanding shares. In addition, Hochschild may earn 60% interest in the Snip project by spending twice the amount Skeena has spent since its original option from Barrick. Since the original acquisition from Barrick, Skeena Resources has reviewed and modelled more than 280,000 m of historical drill data. Surface drilling in 2019 in 10 holes totalled 1934 m and intersected a drill highlight of 1131.91 g/t Au across 1.5 m.

9.1.2. North Central Region

The Lawyers project is a regional-scale prospect that follows northwest-trending linear magnetic and radiometric anomalies with multiple gold-silver showings for more than 20 km. Showings include the Cliff Creek, Dukes Ridge, Phoenix, Marmot and AGB (Fig. 3) zones. Except for Marmot, all zones are considered part of the same system.

In 2019, Benchmark Metals Inc. drilled 47 diamond drill holes totalling 11,000 m. Highlight assays included 4.4 m grading 11.73 g/t Au and 476 g/t Ag at the Cliff Creek zone, 25.0 m grading 2.79 g/t Au and 177 g/t Ag and 2.95 m grading 30.2 g/t Au and 1361 g/t Ag at the AGB zone, 2.87 m grading 46.9 g/t Au and 3056 g/t Ag at the Phoenix zone and 3.34 m grading 7.85 g/t Au and 830 g/t Ag at the Duke's ridge zone. Lower grade envelopes around high-grade vein sets may indicate potential for a bulk tonnage resource. Surface sampling identified a new zone, Marmot East, across an area of 500 by 250 m, where rock grab samples graded up to 24.2 g/t Au and

1425 g/t Ag.

9.1.3. South Central Region

Independence Gold Corp. identified seven gold targets at the **Merit** property in the Spences Bridge belt, based on surface rock samples. A sample from Sullivan Ridge graded 9.5 g/t Au and 341 g/t Ag. They also commissioned a ground magnetic survey over the property. Early-stage metallurgical testing yielded gold recoveries of 99.5% and 96.6% using gravity, flotation, and cyanide leach.

Westhaven Ventures Inc. focussed on drilling the **Shovelnose** low-sulphidation epithermal prospect again in 2019 with a planned 20,000 m program. They were on track to reach that target by the end of the year. They have now identified three northwest-trending gold-bearing vein zones at the South Zone. Vein zone 1 has been extended along strike for about 1000 m with a vertical extent of 300 m. Zone 2 has a 460 m strike length and zone 3 has a 170 m strike length. The company also reported seven new epithermal targets, including drill targets outside the South Zone, resulting from prospecting, ground magnetic (327 line-km), soil (more than 6000 samples) and resistivity surveys (18 km).

Talisker Resources Ltd.'s **Spences Bridge** project was prompted by early signs of a significant epithermal gold discovery at Westhaven's Shovelnose project. 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. Talisker is prospecting for epithermal mineralization and conducting regional stream-sediment sampling to identify targets. They have also been working on a nearby property covering a target area they call the Remington Belt north of the Bridge River camp in Bridge River complex and Taylor Creek Group rocks.

9.1.4. Southeast Region

GGX Gold Corp. continued drilling and trenching at their **Gold Drop** project. The property hosts numerous northtrending, easterly dipping gold-bearing veins that are 10 cm to 2 m thick distributed along steeply dipping strike-slip and normal faults. GGX Gold Corp. has been drilling at the Gold Drop, Everest and C.O.D veins since 2017. Mapping, sampling, and trenching has also identified several other veins, with values of 81.8 g/t Au and 630 g/t Ag in grab sample at the Everest vein, and up to 6.98 g/t Au and 38.6 g/t Ag at the Silent Friend and Ken veins. In 2019, the company continued to drill both the C.O.D. (48 DD holes, 2248 m) and C.O.D. North veins (10 DD holes, 685 m). The company also completed an airborne magnetotelluric survey and identified additional deeper drill targets for late 2019.

9.1.5. Southwest Region

DSM Syndicate returned to its gold vein discovery at their **Gold Standard** project. Channel samples graded 5.86 g/t Au and 14.18 g/t Ag across 12 m, including 5 m of 12.66 g/t Au and

30.20 g/t Ag. They describe mineralization as orogenic quartz vein and shear hosted. Juggernaut Exploration Ltd., a partner in the DSM Syndicate, has agreed on an option deal to earn 100% interest in the property.

At their **Margurete Gold** project, Academy Metals Inc. (formerly Unity Metals Corp.) explored several contiguous properties adjacent to the Phillips Arm gold camp, including Margurete and Hewitt Point. Packsack drill and outcrop samples produced several results of greater than 10 g/t Au. Packsack drill results included a 2 m core sample grading 6.18 g/t Au and 8.1 g/t Ag and a 0.38 m sample grading 8.62 g/t Au and 3.8 g/t Ag. The area has been intermittently explored for gold-bearing quartz veins since the late 19th century. The Doratha Morton mine produced 4627 oz Au and 10,736 oz Ag, mostly in 1898-99, with minor production in 1925 and 1934.

Privateer Gold Ltd. drilled at their **Surespan** project in the Zeballos gold camp, completing about 4400 m in 18 holes by the end of 2019. Some published intersections are consistent with narrow gold vein mineralization like that mined historically in the Zeballos Camp and include: 1386.5 g/t Au across 0.3 m in the recently discovered 88 vein; 5.81 g/t Au across 7.12 m in a 50 m step out from the Prident mine; and 24.20 g/t Au across 0.55 m in an 80 m step out from the White Star mine. Privateer is a private company working mainly on Crown-granted mineral claims and is not obligated to release results. They acquired additional mineral Crown grants (Central Zeballos property) from CanAlaska Uranium Ltd.

9.2. Selected porphyry (Cu-Au, Cu-Mo, Mo) projects 9.2.1. Northwest Region

The **Ball Creek** project was optioned from Evrim Resources in July 2019 for 80% interest in the 52,442-hecratre property, which fully surrounds the Hank property. The property contains seven porphyry gold-copper targets and four epithermal goldsilver targets. Exploration in 2019 included collecting more than 4500 soil samples, geological mapping, and prospecting, which identified new mineralized targets. Approximately 1095 m of deep diamond drilling was completed to test the southwest extension of the Main zone and drilling at Goat zone was also done. The first drill hole testing the southwest extension of the Main zone intersected a feldspar-hornblende \pm biotite porphyry containing localized potassic alteration and copper mineralization. This drill hole added 60 m of strike to the known mineralization at the Main zone. Drill highlights included 291.5 m at 0.14% Cu, 0.48 g/t Au, and 0.95 g/t Ag.

The **Castle** project (formerly known as the Kinaskan-Castle) adjoins the GT Gold property of Tatogga and is the target of potential porphyry Cu-Au and high-grade precious metal veins. Previous work included high-resolution aeromagnetic and radiometric surveys, soil and rock sampling, geological field mapping, and a recent IP survey. Late in 2019, 1555 m of drilling was conducted at the East Castle zone targeting coincident gold and copper anomalies (detected from sampling) and chargeability anomalies.

The Hank project contains epithermal-style (Boiling and

Creek zones) and porphyry-style mineralization (Williams zone). Drilling of 2952 m in 2019 was used to test the continuation of mineralization at depth and to the northeast at the Williams zone. Highlights from drilling included 278 m of potassic altered monzonite and Stuhini Group rocks grading 0.35% Cu, 0.28 g/t Au, and 1.71 g/t Ag. Other drilling tested the Boiling and Creek zones. Previous work at these zones produced drill highlights of 20 m grading 11.63 g/t Au and a 6.8 g/t Ag, but no significant drill intersections were encountered in follow-up work.

Additional brownfield drilling (within mine lease, but outside ultimate pit) of 23 holes totalling 9900 m was completed.

The **Schaft Creek** project is managed through the Schaft Creek Joint Venture (SCJV), where Teck Resources Limited is the operator and holds a 75% interest, while Copper Fox Metals Inc. holds the remaining 25%. In 2019, the SCJV continued environmental studies and revisions to key infrastructure at the main camp. Work is ongoing to complete technical and engineering improvements to reduce capital and operating costs associated with the 133 ktpy mine plan. Shaft Creek is an advanced-stage project where three main porphyry Cu-Au-Mo zones have been identified. Teck Resources (2019) reported a Measured plus Indicated resource of 1.29 Bt grading 0.26% Cu, 0.017% Mo, 0.16 g/t Au and 1.24 g/t Ag, and an Inferred resource of 316.7 Mt grading 0.19% Cu, 0.018% Mo, 0.14 g/t Au, and 1.12 g/t Ag.

GT Gold Corp's Tatogga project contains the Saddle South and Saddle North targets. Work in 2019 was concentrated on the Saddle North target. The Saddle North discovery at Tatogga was identified late in 2018, where follow-up drilling of an IP chargeability anomaly resulted in the discovery of porphyry Au-Cu mineralization from near surface to depths of greater than 1300 m. Initial drilling highlights included 0.62 g/t Au, 0.36% Cu, and 1.17 g/t Ag across 1150 m. Following these initial results, Newmont Corporation placed \$17.6 million into GT Gold with the intention of accelerating exploration and development. Another \$8.3 million was invested by Newmont Goldcorp and intended to finance a preliminary economic assessment. In 2019, GT Gold continued to expand mineralization to depth and along trend. Recent drilling also identified high-grade precious metal veins peripheral to the main body of porphyry mineralization, which included highlights of 4.11 m of 25.42 g/t Au, and 15.70 m of 6.21 g/t Au. A detailed geological model and resource estimate and economic evaluation of Saddle North is expected to be released by the end of the first quarter in 2020.

In 2019, Brixton Metals Corporation increased its mineral claim tenure to 1858 km² for its **Thorn** project. Mapping and soil-rock geochemistry at the Chivas zone expanded the porphyry target 3 km along strike and it remains open. Brixton completed a 9.1 line-km IP-magnetotelluric survey across the Camp Creek copper corridor, which also contains the Oban diatreme breccia pipe and Glenfiddich zone. Exploration in 2019 included 8042 m of drilling; highlights from Oban were 0.57 g/t Au, 0.24% Cu, 43 g/t Ag, 0.55% Zn, and 0.28% Pb

across 554 m.

The **Treaty Creek** project is owned by Tudor Gold Corp. (60%), Teuton Resources Corp. (20%) and American Creek Resources Ltd. (20%), and borders the KSM property to the southwest and the Brucejack property to the southeast. Drilling in 2019 focussed on the Goldstorm zone, which resembles porphyry Au-Cu mineralization, but with a basemetal association. Drilling, which totalled 9780 m in 14 holes, returned highlights of 2.006 g/t Au across 87 m, within 336 m averaging 1.004 g/t Au. Silver and copper mineralization is associated with deeper gold horizons and remain open in all directions.

9.2.2. North Central Region

The Atty project (Serengeti Resources Inc.) is adjacent to Centerra Gold Inc.'s Kemess property. In 2019, 29.8 line-km of IP geophysics and follow-up diamond drilling (six holes, 2318 m) were carried out. Highlight drilling results included 87.7 m of 0.04% Cu, 0.14 g/t Au and 0.4 g/t Ag.

The **Chuchi** copper-gold project is at the northeast margin of the Hogem batholith (Early Jurassic to Early Cretaceous), where a cluster of porphyritic monzonite stocks, dikes, and sills intrude the Chuchi Lake succession of volcanic and sedimentary rocks. In 2019, Centerra Gold Inc. carried out a 731 line-km low-altitude aeromagnetic survey and 1755 m of diamond drilling in 4 holes.

Centerra Gold Inc.'s **Kemess East** project (KE), about 1 km east of KUG, is an underground operation that could be integrated into the KUG project and use facilities developed for KUG. KE has an Indicated resource of 113.1 Mt grading 0.38% Cu, 0.46 g/t Au and 1.95 g/t Ag and an Inferred resource of 63.8 Mt grading 0.34% Cu, 0.31 g/t Au, and 1.90 g/t Ag.

Kwanika Copper Corporation (65% Serengeti Resources Inc., 35% Posco International Corporation) was formed in 2017 to continue exploration on the **Kwanika** project. Since 2006, about 82,650 m of drilling has been done on Kwanika (Central and South zones). Based on open-pit and underground data, an updated resource was announced for the Central Zone in 2019, with Measured and Indicated values of 223.6 Mt grading 0.27% Cu, 0.25 g/t Au and 0.87 g/t Ag containing 1.32 Blbs of Cu, 1.83 Moz of Au and 6.27 Moz of Ag. The company planned to release a prefeasibility study but determined that it lacked the necessary funding and instead will focus on completing an interim study report.

At **Mt. Milligan**, Centerra Gold Inc. carried out a brownfieldgreenfield low-altitude 640 km aeromagnetic survey and planned a 32 line-km IP survey near the mine site. Centerra reported that they had planned to complete 22,500 m of near-pit infill drilling by the end of 2019.

9.2.3. South Central Region

Troubadour Resources Inc. drilled 1075 m in four holes at their **Amarillo** project. Three targeted a coincident geochemical, IP, and magnetic anomaly and the fourth a chargeability high. Before drilling, they carried out mapping, prospecting, and sampling. Amarillo is about 10 km south of the Brenda past-producing Cu-Mo porphyry. Like Brenda, the target is calk-alkaline porphyry mineralization related to the underlying Pennask batholith.

At their **Miner Mountain** project, Sego Resources Inc. identified new targets through data compilation and reviewing existing drill core. Trench sampling returned 18 m grading 0.96% Cu and 0.31 g/t Au early in the year. Multiple targets at Miner Mountain are alkalic copper-gold type. Sego reported targets at the Cuba, Empress, South, and Sovereign zones for potential drilling in 2020. They have a multi-year permit for drilling and trenching.

Dunnedin Ventures Inc. carried out 1766 m of drilling in 3 holes, mapping, prospecting, and sampling at their **MPD** project. MPD is a consolidation of the Man, Prime, and Dillard alkalic porphyry Cu-Au targets. Significant surface results include 0.89% Cu across 46 m in a trench sample at the Man area, and grab sample results of 0.80% Cu with 0.32 g/t Au at Dillard, 2 m of 0.49% Cu with 0.26 g/t Au and a grab sample grading 1.03 g/t Au with 9.40 g/t Ag at Prime.

Pacific Ridge Exploration Ltd. drilled 1087 m in 4 holes at their **Spius** project, encountering low-grade copper-molybdenum mineralization and porphyry-style mineralization. They note the highest grades at the bottoms of two holes and in the north of their target area.

9.2.4. Southwest Region

During mapping and sampling reconnaissance work, ArcWest Exploration Inc. sampled up to 21.2 g/t Au and 15 g/t Ag in an apparent epithermal zone at their **Teeta Creek** project, primarily known as a porphyry Cu-Mo prospect. The area was drilled in 1968 and 1975 with at least one encouraging copper intersection. Teck Resources Limited has entered into an agreement to explore the property to earn an initial 60%.

9.3. Selected polymetallic base and precious metal projects **9.3.1.** Northwest Region

In 2019, Pretium Resources Inc. drilled more than 15,000 m at their **Brucejack Regional** project prospects. Drilling early in the year was focussed on epithermal (Tuck and Lilliane zones), and VMS targets (A6 and Canoe zones). Intrusion-related gold (Koopa zone) targets were drilled later in the year. Regional grassroots sampling, regional mapping, prospecting, geophysics, and hyperspectral mapping were also conducted on the Bowser mineral claims. At the A6 zone, mineralization is in Iskut Formation mudstones in a section containing pillowed and massive basalts and a 150 m-thick interval of sericite-chlorite altered rhyolite. This bimodal volcanism is similar to that at the Eskay Creek deposit. Drill highlights from the mudstone are 1.5 m grading 2890 g/t Ag and 1.81% Cu.

The **Dolly Varden** project (Dolly Varden Silver Corporation) is an advanced-stage property that consists of the Torbrit, Dolly Varden, Wolf, Northern Star, and Bonus zones, where four mineralized facies of exhalative stratiform mineralization are recognized. In 2019, the company conducted preliminary

metallurgical testing, 11,000 m of drilling, geochemical sampling, prospecting and geological mapping. Drilling at the Chance target intersected highlights of 15.20 m grading 488.3 g/t Ag, 0.55% Pb, and 0.05% Zn. Dolly Varden released an updated mineral resource in 2019, with total Indicated resources of 3.42 Mt grading 299.8 g/t Ag and an additional Inferred resource of 1.29 Mt grading 277.0 g/t Ag.

Skeena Resources Limited drilled at their **Eskay Creek** project. The past-producing Eskay Creek mine is considered a VMS-type deposit and was one of the highest grade gold mines in the world and fifth-largest silver producer by volume, with 3.3 Moz of Au and 160 Moz of Ag (average grades of 45 g/t Au and 2224 g/t Ag). Drilling in 2019 focussed on upgrading areas of Inferred resources into the Indicated category. Highlights include 312.81 g/t Au and 95 g/t Ag across 2.21 m and separately 6.75 g/t Au and 285 g/t Ag across 27.50 m. A pit-constrained Indicated mineral resource is reported at 12.65 Mt at 4.3 g/t Au, 110 g/t Ag with an Inferred resource of 14.42 Mt at 2.3 g/t Au, and 47 g/t Ag. An underground Indicated resource of 819,000 t at 6.4 g/t Au and 82 g/t Ag were reported.

At the **Golddigger** project in 2019, Goliath Resources Limited discovered a new zone (Sure Bet) during field reconnaissance that followed-up targets generated by lidar and geochemical sampling data. Contained in a broad alteration halo, the zone is cut by multiple NW-SE trending structures that host polymetallic massive sulphide mineralization (galena-sphalerite-pyrite). A single channel sample resulted in 8.4 m of 7.37 g/t Au, including 3.4 m of 17.68 g/t Au. More than thirty chip samples were collected; most returned assays >1.4 g/t Au.

Etruscus Resources Corp.'s **Rock and Roll** project lies in the Iskut River valley and includes the Black Dog VMS deposit which was discovered 30 years ago. Black Dog has an Inferred mineral resource estimate of 2.02 Mt grading 0.71 g/t Au, 87.1 g/t Ag, 0.23% Cu, 0.23% Pb, and 0.98% Zn. Because of thick overburden, Etruscus Resources conducted a biogeochemical orientation survey, which tested pathfinder elements (Au, Ag, Ba, Cu, Fe, Hg, Pb, Se, Zn) in 58 bark samples over known and unknown mineralized areas. In addition to surface sampling, approximately 2500 m of diamond drilling was conducted.

The **Scottie Gold Mine** project is operated by Scottie Resources Corp., who changed their name from Rotation Minerals Ltd. early in 2019. The property hosts the past-producing Scottie Gold mine which produced 95,400 oz of gold. Mineralization consists of gold-bearing quartz-calcite sulphide veins that appear to be coeval with sub-parallel shear and fracture zones of the Texas Creek suite, specifically the Summit Lake pluton. In 2019, the company began surface geochemical sampling, completed 2050 m of diamond drilling, followed up on near-surface historic high-grade mineralization on the newly acquired Bow property, and explored recently deglaciated outcrops. The Domino zone, which is 1.9 km west of the past-producing Scottie Gold mine, produced assay results from grab samples of 536 g/t Au and 735 g/t Ag and a chip sample gave 10.5 g/t Au and 14 g/t Ag across 5.3 m. The

Domino zone consists of several discrete 200 m-wide shear structures that continue parallel for more than 700 m along strike.

Ascot Resources Ltd. acquired **Silver Coin** late in 2018. The deposit has similar host rocks and ore minerology to that of the Premier and Big Missouri deposits. Silver Coin contains existing underground infrastructure and the central parts of the deposit are drilled sufficiency to warrant resources being classified in the Indicated category. The 10,500 m drill program this year was designed to infill and provide geotechnical context. Drilling highlights include 52.67 g/t Au across 3.59 m. An Indicated mineral resource is reported at 0.70 Mt grading 4.46 g/t Au and 17.9 g/t Ag with an additional Inferred resource of 0.97 Mt grading 4.39 g/t Au and 19.0 g/t Ag.

In September, New Nadina Explorations changed its name to Equity Metals Corporation, and its flagship project is the **Silver Queen** project. Mineralization is similar to the Equity Silver mine, where it is characterized as a transitional porphyry-epithermal type deposit. Polymetallic mineralization is in 1-2 m-wide quartz-calcite-barite veins as disseminated to locally massive sphalerite, galena, chalcopyrite, and sulfosalts. In 2019, historic data were compiled and interpreted and, in August, a mineral resource estimate was released with Indicated resources of 0.815 Mt at 6.35% Zn, 3.24 g/t Au, 201.4 g/t Ag, 0.26% Cu, and 0.96% Pb with additional Inferred resources of 0.801 Mt at 5.21% Zn, 2.49 g/t Au, 184.3 g/t Ag, 0.31% Cu, and 0.88% Pb (resources at NSR cut-off of \$100/t).

Strikepoint Gold Inc. acquisitioned the **Willoughby** project in 2019 from ArcWest Exploration. The project is adjacent to Ascot's Red Mountain project and is approximately 30 km east of Stewart. The property has 4625 m of historic drilling on six zones and contains underground workings excavated in the 1990s. Gold-silver mineralization is in Early Jurassic volcanic and sedimentary rocks and is thought to be associated with the 'Goldslide suite' intrusive complex. In 2019, hand-trenching and channel sampling was conducted along with about 2000 m of diamond drilling. Drilling at the North zone produced highlights of 26.28 g/t Au and 95.00 g/t Ag across 4.0 m, and surface sampling near the Wilkie zone returned a grab sample of 67.3 g/t Au and 164.0 g/t Ag.

9.3.2. North Central Region

ZincX Resources Corp. continued exploration on its Akie SEDEX project, which incudes the Cardiac Creek deposit. The deposit is hosted by siliceous, carbonaceous, fine-grained siliciclastic rocks of the Gunsteel Formation (Middle to Late Devonian). At a base case 5% zinc cut-off, the deposit has an Indicated resource of 22.7 Mt grading 8.32% Zn, 1.61% Pb and 14.1 g/t Ag and an Inferred resource of 7.5 Mt grading 7.04% Zn, 1.24% Pb and 12.0 g/t Ag. In 2019, ZincX carried 2347 m of diamond drilling in four holes, focussing on the high-grade core of the deposit. Highlight results included 10.94 m (true width) of 10.85% Zn, 2.23% Pb, and 17.0 g/t Ag and 14.65 m (true width) of 16.20% Zn, 3.39% Pb, and 27 g/t Ag.

InZinc Mining Ltd.'s Indy project area has been of exploration

interest since the early 1980s. Targets have generally been categorized as a Mississippi Valley-type (MVT), although SEDEX affinities have long-been recognized. A maiden drill program in 2018 identified a new SEDEX mineralized discovery (B-9 zone) and results included 6.29 m of 12.33% Zn, 2.98% Pb, and 24.5 g/t Ag. In 2019, soil geochemical surveys (1194 samples), mapping and prospecting were carried out. Results identified several targets, the largest being a 1.5 km-long multielement geochemical target defined by distinctive SEDEX pathfinder elements in soil samples and rock exposures. This target is 5 km northwest of the B-9 zone.

The Stardust property was acquired by Sun Metals Corp. in 2017. Historically regarded as a skarn deposit, it was explored intermittently for many years. Historic work included more than 80,000 m of drilling, 5800 soil samples, airborne magnetic surveys, mapping, and prospecting. Mineralization is hosted by the Sowchea, Pope and Copely successions west of the Pinchi fault, in the Cache Creek terrane. In 2018, Sun Metals reported discovering a new zone (421 zone) and drilling results included a 100 m intersection grading 2.51% Cu, 3.03 g/t Au, and 52.5 g/t Ag. Sun Metals began drilling in May 2019, which continued into the fall with plans for extension into 2020. Estimated drilling for 2019 was 15,000 m in 27 holes. Highlight 2019 results for the 421 zone included 24.85 m of 3.13% Cu, 4.8 g/t Au and 93.45 g/t Ag, and 58.01 m of 2.49% Cu, 2.61 g/t Au and 44.3 g/t Ag. Results confirm continuity of mineralization down dip and to the south of the 2018 discovery hole.

9.3.3. South Central Region

Engold Mines Ltd. drilled its **Lac La Hache** project in early 2019, stepping out at the Aurizon target. Initial results extended narrow quartz-carbonate gold veins along strike. Engold resumed drilling late in the year and carried out soil surveys on four target areas. Drill results included 6.18 g/t Au, 0.80% Cu and 2.63 g/t Ag across an interval of 4.55 m. 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 10).

At the **New Craigmont** project, Nicola Mining Inc. announced results of 2018 drilling on both historically mined material piled in waste terraces and in the Craigmont Central zone early in the year. They carried out additional drilling to test the Central zone in 2019. Highlights from the No. 3 mineralized body include 84 m of 0.34% Cu, 44 m of 0.45% Cu, and 13 m of 0.65% Cu with magnetite. Other work included soil geochemistry, mapping, analysis of historic core, and multispectral mapping. They are also developing a resource estimate for the Craigmont mine waste terraces. The material was tested using X-ray transmission sorting technology. In five out of eight tests, grades were increased to greater than 1% Cu with up to 50% Fe. They are also carried out flotation tests.

The Merritt Mill is at the Craigmont mine site. It has undergone about \$3 million in recent modifications but is not yet recommissioned. 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.

GSP Resources Corp. had a seven-hole 1200 m November drill program at its **Olivine Mountain** project in the Tulameen complex. Grab sampling returned encouraging Cu, Au, and Pd values from target areas and initial drilling intersected visible sulphide. Drilling follows mapping, soil geochemistry, and an airborne VLF-EM survey in 2018. The Tulameen complex is an Alaskan-type Late Triassic mafic-ultramafic intrusion.

9.3.4. Southeast Region

Rokmaster Resources Corp. previously compiled historic data and resampled historic drill core for their **Duncan** project. Results include 7.5 m grading 6.2% Zn + 6.3% Pb, 4.8 m grading 11.4% Zn + 0.8% Pb, and 6.9 m grading 7.1% Zn + 4.6% Pb. New forestry cutblocks on the property in 2019 exposed additional outcrops, and additional mapping, soil geochemistry, and rock sampling was done. The company also conducted environmental baseline work, and drill permits were received late in the year. The Duncan property has been intermittently explored since the 1950s. Drilling by Cominco between 1989 and 1997 outlined zinc-lead mineralization along a 650 m strike length. Several zones of mineralization exist on the property as steeply dipping, stratiform, bodies on the east limb of the Duncan anticline.

Magnum Goldcorp Inc. has been drilling at their **LH** project in the past few years, with intersections including 8.5 m grading 7.10 g/t Au. Gold mineralization appears to be associated with pyrrhotite+/-arsenopyrite, which provide conductive targets that are coincident with ground geophysics magnetic anomalies. In 2019, they completed a helicopter-supported drill program (4 DD holes, 250 m) to follow up on 2015 drilling on the western end of a magnetic anomaly. Present and historic drilling has identified at least two mineralized intervals 1 to 8.75 m thick. Highlight results from 2019 include 5.58 m grading 4.068 g/t Au, with 0.27 m grading 22.8 g/t Au.

Apex Resources Inc.'s Ore Hill project was under option to Margaux Resources Ltd. in 2017 and 2018. Margaux carried out mapping and sampling along a gold soil geochemical anomaly and identified gold mineralization in a 10 m wide breccia zone along a north-trending fault. The soil anomaly traced the fault for more than 1500 m across the Summit and Ore Hill claims, and rock sample results included 119 g/t and 105 g/t Au collected across an area 950 by 150 m. In 2019, Apex Resources Inc. compiled historic data, and identified two linear, north-trending magnetic anomalies from an airborne Heliogeotem survey that was flown in 2009. The western anomaly coincides with the soil and rock geochemical anomaly, whereas the eastern anomaly coincides with historic production from the Queen mine at its northern end. Apex mapped and sampled to confirm grades from the previous work and late in the year began a 600 m drill program, which encountered visible gold. The Ore

Hill property is in the historic Sheep Creek gold mining camp.

Affinity Metals Corp.'s **Regal** project covers 5891 ha and hosts multiple past-producing mines including the Regal Silve mine, the Allco silver mine and the Snowflake mine. In 2011, Northaven Resources Corp. completed 1354 linekm of airborne geophysical work over the area and identified linear magnetic and conductive anomalies that are coincident with historic MINFILE showings. In 2018, Affinity Metals Corp. optioned the property, compiled historic data, and did additional mapping. At the Allco property, 22 grab samples assayed up to 4420 g/t Ag, 2.27% Cu, 26.4% Zn, >20% Pb, and 5.68 g/t Au. Further interpretation was done on the 2011 geophysical survey, and drilling was completed late in 2019 at Allco (10 DD holes), and Regal (11 DD holes). Total combined metreage was 1846.

Teck Resources Limited continued work at their **Sweet Spot** project in 2019. Recent focus in the Purcell anticlinorium has been on geophysical methods to further identify structures and thickness variations in the Aldridge Formation that may indicate sub-basin development and potential SEDEX mineralization. In the last several years, the company has re-logged core, mapped, and sampled and identified target areas. They conducted additional geophysical work, including magnetotelluric studies to delineate targets, and in 2019 they drilled (2 DD holes, 1371 m) continued mapping and conducted petrophysical studies.

9.3.5. Southwest Region

Bayhorse Silver Inc. has optioned the **Brandywine** past producer and began compiling historical data and preliminary work at the site, including resampling of 2010 drill core. Metallic screen assays in some cases yielded significantly higher Au results (e.g., 11.42 vs. 3.73 g/t across 3.1 m and 20.20 vs. 6.23 g/t Au across 1.6 m). In 1977-78, about 10,000 t of ore from Brandywine yielded 23,000 oz Ag and 11,000 oz Au, with Pb, Zn and Cu co-products.

9.4. Selected Ni-Cu-Co-precious metal projects 9.4.1. Northwest Region

Drilling in 2017 at the **Nickel Mountain** project (Garibaldi Resources Corp.), which contains the E&L zone, returned 16.75 m of core with 8.3% Ni, 4.2% Cu, 0.19% Co, 1.96 g/t Pt, 4.5 g/t Pd, 1.1 g/t Au, and 11.1 g/t Ag. Exploration in 2019 was designed to infill the five known zones of mineralization and further explore at depth and along strike. Approximately 25,000 m were drilled in 2019 and highlights include 18.2 m grading 7.04% Ni, and 3.81% Cu in a broader zone of mineralization of 86.5 m grading 1.88% Ni and 1.32% Cu.

Giga Metals Corporation's **Turnagain** project has four main zones of mineralization (Horsetrail, Northwest, Hatzl, and Duffy) that contain sulphide mineralization as pyrrhotite, pentlandite, chalcopyrite, and trace bornite, in the Turnagain ultramafic intrusion (Early Jurassic). In September of 2019, an updated Measured plus Indicated resource was reported of 1.073 Bt grading 0.220% Ni and 0.013% Co, and an Inferred resource of 1.142 Bt grading 0.217% Ni and 0.013% Co. These Measured plus Indicated resources equate to 5.2 Blbs of Ni and 312 Mlbs of Co, a 28.3% increase in Ni from the previous estimate. The updated estimate was based on an additional 36 infill drill holes totalling 8940 m drilled previously in 2018. A Preliminary Economic Assessment is expected as early as first quarter of 2020.

9.4.2. North Central Region

FPX Nickel Corp.'s **Decar** project contains ultramafic rocks mineralized with the naturally occurring nickel-iron alloy, awaruite. In 2019, FPX Nickel reported bench-scale test results for metal extraction and are considering testing a 10,000 t bulk sample. A conventional flow sheet based on grinding, magnetic separation, and flotation processes consistently produced clean nickel concentrates grading 63 to 65% Ni with significant improvements in recovery relative to previous testing. By-product iron ore concentrates graded 60 to 65% Fe.

9.5. Selected specialty metal projects

Speciality metal exploration projects include Defense Metals Corp.'s **Wicheeda** project in the North Central Region and Delrey Metals Corp.'s **Peneece** project in the Southwest Region.

9.5.1. North Central Region

Defense Metal Corp.'s Wicheeda project is a deformed carbonatite intrusion that hosts light rare earth elements (LREE). The core of the intrusion is a dolomite carbonatite, which transitions outward to a calcite carbonatite. Hydrothermal veins and plugs in the dolomite carbonatite are mineralized with REE flourocarbonates, ancylite (cerium, lanthanum) and monazite (cerium, lanthanum, neodymium). Minor concentrations of niobium are present as well. In 2019, Defense Metals completed a 30 t bulk sample and in June released a report that set out, at a 1% LREE cutoff, an Inferred resource of 11.37 Mt grading 1.14% Ce, 0.53% La, 0.23% Nd, 0.04% Nb, 0.01% Sm and 1.96% LREE. In September, the company completed drilling a total of 2005 m in 13 holes which left the deposit open to the north and west. Highlight results included 83 m of 4.43% light rare earth oxides (LREO; lanthanum, neodymium, praseodymium, and samarium oxides) and 58 m of 4.01% LREO.

9.5.2. Southwest Region

Delrey Metals Corp. flew an airborne survey and identified a large magnetic anomaly at its **Peneece** iron-titanium-vanadium project. Delrey increased the size of their land holdings to cover the anomaly. Previously called Wigwam Magnetite, this prospect comprises a large, low-grade (5-10%) titaniferous magnetite deposit. Magnetite also has elevated vanadium. It was first recognized as a large magnetic anomaly in the late 1950s or early 1960s. Relatively little work has been done but it appears as though diorite, metasedimentary and metavolcanic rocks host fine- to coarse- gabbro or hornblende pyroxenite dikes or veins with 5-10% magnetite.

9.6. Selected coal projects

Coal exploration projects included Colonial Coal International Corp.'s **Huguenot** project in the Northeast Region and Pacific American Coal Limited's **Elko** project in the Southeast Region.

9.6.1. Northeast Region

Colonial Coal International Corp. announced a Preliminary Economic Assessment for an open-pit-only mine for its Huguenot project. This revises a previous PEA for a combined open-pit and underground operation. Two scenarios for the open-pit-only mine capital expenditures were reported. Based on the purchased equipment scenario the financial analysis suggested that the coal price required to achieve a zero NPV at discount rates of 5%, 7.5% and 10%, respectively, is about US\$113, US\$120 and US\$125 t. A coal price of US\$137 per t is required for an IRR of 15%. Based on the leased equipment option, the financial analysis suggested that the coal price required to achieve a zero NPV at discount rates of 5%, 7.5% and 10%, respectively, is about US\$114, US\$119 and US\$125 per t. A coal price of US\$137 per t is required for an IRR of 15%. Measured and Indicated surface mineable coal resources total 132.0 Mt, with an additional Inferred resource of 0.5 Mt. The conceptual open pit would yield 72 Mt of product coal during a mine life of 27 years.

9.6.2. Southeast Region

Pacific American Coal Limited released results of their 2018 drilling, and continued work on their Elko project. In the 2018 drilling (RC and large-diameter; 3451 m), six coal seams were encountered in the Mist Mountain formation, ranging in thickness from 2.41 to 12.70 m. Geological modeling suggests that these seams are continuous across the property. Three additional seams were encountered in the overlying Elk Formation, and range in thickness from 1.77 to 2.60 m. Coal quality test results indicate seven of the nine seams are mid-volatile, low-ash coking coal. The bottom two seams are mid-volatile, semi-hard coking coal to PCI metallurgical coal, but more work needs to be conducted to determine the characteristics of a blended product. In 2019, the company used the 2018 drilling results to update their JORC resource estimate of 117.6 Mt Measured + 93.2 Mt Indicated + 92.3 Mt Inferred. Block modeling indicates potential for a small opencut operation and a larger underground operation.

9.7. Selected industrial mineral projects

Industrial mineral exploration projects include Sil Industrial Minerals Ltd.'s **Sil** project in the Northeast Region, Leo Lindinger's **Mont** property in the South Central Region, and MGX Minerals Inc.'s **Gibraltar** project in the Southeast Region. Sil Industrial Minerals Ltd. continued to explore the17-001, 002, and 003 targets on their **Sil** project. In 2018, the company completed initial exploration on a multi-year project in search of frac sand resources in sandy post-glacial sediments. In 2019, the 17-001 target area was sampled with 70 drill holes totalling 500 m, the 17-002 target area was sampled with 10 drill holes totalling 50 m and the 17-003 target area was also sampled with 10 drill holes totalling 50 m.

9.7.2. South Central Region

Following test pits in 2018, Leo Lindinger drilled the **Mont** property, a bentonite prospect in an accessible area. All three holes intersected bentonite clay. Results so far suggest this is a large deposit. Historically the area has been explored mainly for gold, copper, zinc, and silver in epithermal, hot spring or porphyry and transitional vein environments. Recognition of a potentially economic bentonite deposit is recent.

9.7.3. Southeast Region

In 2019, MGX Minerals Inc. continued to explore at their **Gibraltar** project. In 2018, MGX shipped a one-ton sample to an independent lab in Germany (Dorfner Anzaplan) for testing. Results indicated that the material could be suitable as medium quality feedstock for metallurgical-grade silicon metal production. They mapped and sampled on the property, reporting assay results between 97.8 and 99.9% SiO₂, and began an eight-hole drill program late in the year. In 2019, they drilled (5 DD holes, 200 m) to follow up on their 2018 work.

10. Publically funded geoscience

10.1. The British Columbia Geological Survey

The British Columbia Geological Survey (BCGS) conducts research to establish the geological evolution and mineral resources of the province. It partners with federal, provincial, and territorial geoscience agencies, and other national and international organizations. Drawing on continuously advancing concepts and technologies, the Survey creates knowledge to guide societal decisions centred on the Earth sciences. It connects government, the minerals industry, and communities to the province's geology and mineral resources. The information provided by the Survey is used for effective mineral exploration, sound land use management, and responsible governance, benefitting decisions that balance the economy, the environment, and community interests. The Mineral Development Office is the Vancouver base of the British Columbia Geological Survey. It links the more than 800 exploration and mining companies headquartered in Vancouver to provincial mineral and coal information. The MDO distributes Survey data and provides technical information and expertise about mineral opportunities to the domestic and international investment community. Celebrating its 125th anniversary in 2020, the British Columbia Geological Survey is the oldest scientific organization in the province.

The largest field project in 2019 was centred on northern

9.7.1. Northeast Region

Hogem batholith. In its second year, the project will provide a modern understanding on the controls of diverse mineralization types in the region and includes both bedrock and surficial mapping. An ancillary project evaluated the production of digital elevation models from drone-mounted optical systems, and how these models can be used to support field mapping and exploration. North of the Hogem batholith, the second year of a TGI-5 partnership with the Geological Survey of Canada was completed. This study, designed to establish the geological framework and geochronology of the Polaris ultramafic intrusion, will be integrated with work on the Tulameen ultramafic body to create a new model for Ni-CU-PGE oreforming processes in these Alaskan-type intrusions. Another study in the North Central Region, conducted in conjunction with the University of British Columbia, examined alteration and protoliths in serpentinized rocks of the Trembleur ultramafic unit in the Decar area to better understand the formation, distribution, and abundance of brucite, which is capable of sequestering atmospheric CO₂, and awaruite, a potential source of nickel. In the Golden Triangle of northwestern British Columbia, a new multi-year mapping project was started near Kitsault to further refine the stratigraphy of the Hazelton Group and associated mineralization. A pilot project was undertaken in northern Vancouver Island to test panned stream-sediment and water geochemistry combined with Pb isotopic compositions to explore for metallic deposits in glaciated terranes. Program results are presented each year at an Open House held in Victoria and at annual meetings such as Roundup, the PDAC, KEG, Minerals North, and Minerals South. Results are also published in Geological Fieldwork (Fig. 16), a volume of papers released each January, and by GSC and Geoscience BC partners.

As the steward of mineral and coal resources in the province, the Survey has an important role in stimulating activity, attracting investment, and providing continuous research based on a corporate memory that extends back more than 125 years. As custodian of all provincial public geoscience data, the BCGS preserves, archives, and provides free webbased access to information. The BCGS houses, maintains and regularly updates numerous databases, including MINFILE, COALFILE, Property File, the Assessment Reports Indexing System (ARIS), digital bedrock geology, regional geochemical surveys, and a publications catalogue. MapPlace, the BCGS geospatial web service, provides open geoscience data and custom map-making tools to help decision-makers from diverse disciplines reduce the costs of accessing and analyzing information.

10.2. The Geological Survey of Canada

The BCGS and the Geological Survey of Canada (GSC) continue to deliver projects through the second iteration of the Geo-mapping for Energy and Minerals (GEM 2) program, which is aimed at advancing geological knowledge and further developing modern geological maps and data sets and will run until 2020, and through the Targeted Geoscience Initiative 5



Fig. 16. The British Columbia Geological Survey is celebrating its 125th anniversary in 2020. Each year it publishes Geological Fieldwork, a Summary of Fieldwork and Current Research, the Provincial Overview of Mining and Exploration in British Columbia (this volume), and the British Columbia Coal Industry Overview. Top photo of camp move to Highland Valley in 1910. Bottom photo of camp move near eastern Hogem batholith in 2018.

(TGI-5) program. The TGI-5 program is directed at building knowledge and developing methods to better target buried mineral deposits. It aims to understand the geological processes responsible for deriving, transporting, and depositing ore metals. In addition, surficial geology and glacial history studies will provide vital knowledge for mineral exploration in covered regions.

10.3. Geoscience BC

Geoscience BC, a not-for-profit, non-government geoscience organization funded by provincial government grants, also provides provincial geoscience information. Geoscience BC is industry-led and supports mineral and oil and gas investment to British Columbia through the funding and delivery of geoscience data produced by third parties. Geoscience BC awards contracts for large geophysical and geochemical programs and provides grants to universities and consultants for targeted geoscience projects typically generated through requests for proposals. Geoscience BC is governed by a volunteer board of directors and receives technical direction from volunteer technical advisory committees (mineral exploration, oil and gas, and geothermal) whose membership is largely drawn from the exploration industry.

11. Foreign investment initiatives

Opportunities exist for companies to attract foreign investment using government services and staff. The province participates in international investment missions showcasing mineral and coal opportunities. If you are interested in profiling your projects or investment opportunities in upcoming events, connect with the Mineral Development Office in Vancouver for more information.

12. Concluding remarks

Exploration expenditures decreased slightly from 2018 but explorationists continued to define, and expand porphyry and porphyry-related Cu-Au and Cu-Mo deposits, gold deposits of various types, and stratiform base-metal, specialty metals, industrial minerals, and coal deposits. Even though exploration expenditures were down slightly, there were several investments highlighting British Columbia as a favourable mining jurisdiction. Newcrest Mining Limited acquired a 70% interest in the Red Chris mine for a final purchase price of \$804 million US, creating a joint venture with Imperial Metals Corp. (remaining 30% interest), Ascot Resources Ltd. acquired IDM Mining Ltd. for \$45 million, Newmont Corporation invested \$25.9 million in GT Gold Corp.'s Tatogga project, Osisko Gold Royalties Ltd. acquired Barkerville Gold Mines Ltd. for about \$338 million and Talisker Resources Ltd. acquired Bralorne Mines Ltd. for shares and a cash payment of \$8.7 million.

At the end of 2019, nine metal mines and seven coal mines were in production. During the year one metal mine (Mount Polley) and two coal mines suspended production (Quinsam and Coal Mountain). One new industrial mineral mine (Kootenay West) was under construction.

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Exploration and mining in the Northwest Region, **British** Columbia

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1. Introduction

The Northwest Region (Fig. 1) is well known for its remarkable endowment of economic minerals. It has a long history of exploration and mining, which extends back more than a century. Including a loosely defined area popularly known as the 'Golden Triangle', the region has high potential for deposits such as large bulk-tonnage porphyry Cu-Au-Mo, high-grade Au-Ag precious metal, Ag-Pb-Zn polymetallic, ultramafic-hosted Ni-Co-Pt-Pd, anthracite coal, placer gold, and jade. The Skeena arch, host to many large past-producing Cu-Au porphyry projects, is seeing renewed exploration interest and investment. Continued improvements to infrastructure in the region will improve the economical viability of proposed projects. New outcrops exposed due to glacier retreat in the region will help exploration.

In 2019, exploration expenditures and other exploration metrics are captured in the British Columbia Mineral and Coal Exploration Survey. For the Northwest Region, exploration expenditures were estimated at \$180.8 million, while exploration drilling was approximately 266,700 m (Clark et al., 2020; EY LLP, 2020).

The Northwest Region contains three operating mines (Brucejack, Red Chris, and Silvertip) and five proposed projects (Galore Creek, KSM, Red Mountain, Kutcho, and Tenas). More than 80 exploration projects were tracked, of which more than 30 are discussed herein. The region is prospective for a diversity of deposits, although in 2019 exploration focussed on porphyry Cu-Au and high-grade precious metal mineralization. Several new large construction projects in the region are creating significant need for aggregate. Placer gold and jade mining continues throughout the region.

Major companies are making large investments in the region. This year Australian-based Newcrest Mining Limited invested \$804 million US for 70% interest in the Red Chris mine and Newmont Corporation placed a combined \$25.9 million financing and strategic investment into GT Gold Corp. to expedite exploration and development at the Tatogga project. Domestic acquisitions and optioning are ongoing; notably, Ascot Resources purchased the Red Mountain project from IDM Mining Ltd. for \$45 million.

Several companies reported positive drill results on recent discoveries, while other projects were advanced towards the feasibility stage. Step-out drilling by Teuton Resources Corp. at the Goldstorm zone of the Treaty Creek project intersected a large mineralized system and the company reported 2.006 g/t Au across 87 m, within 336 m averaging 1.004 g/t Au. GT Gold continued reporting positive drill intersections at their Tatogga project at the North Saddle target with the main porphyry body returning highlights of 500 m grading 0.91 g/t Au, 0.55% Cu, 1.34 g/t Ag. Adjacent high-grade precious metal veins returned 4.11 m grading 25.42 g/t Au and 15.70 m grading 6.21 g/t Au. At Brixton Metals Corporation's Thorn project, drilling on the Oban zone returned 554 m of 0.57 g/t Au, 0.24% Cu, 43 g/t Ag, 0.55% Zn, and 0.28% Pb. At their Hank property, Golden Ridge Resources Ltd. followed up a 2018 porphyry discovery with continued drilling at Williams zone and reported 0.35% Cu, 0.28 g/t Au, and 1.71 g/t Ag across 278 m. Drilling at their **Ball Creek** project Main zone intersected 291.5 m at 0.14% Cu, 0.48 g/t Au, and 0.95 g/t Ag.

2. Geological overview

The mineral endowment of British Columbia, including the Northwest Region, is intimately tied to the tectonic evolution of the Canadian Cordillera (e.g., Nelson et al., 2013). Mineral deposits formed during protracted Neoproterozoic to Cambrian breakup of the supercontinent Rodina, accretion of allochthonous terranes to the western flank of ancestral North America, and post-accretion deformation and magmatism. The Canadian Cordillera is commonly subdivided into five morphogeologic belts (from east to west, Foreland, Omineca, Intermontane, Coast, and Insular; Fig. 1) across which the Northwest Region extends. Late Triassic to Early Jurassic island arc volcanism, plutonism, and tectonics in the Stikine terrane were particularly important to the Northwest Region, generating many porphyry Cu-Au-Mo and Au-Ag vein deposits.

3. Mines and quarries

In 2019, three metal mines operated in the Northwest Region (Brucejack, Red Chris, and Silvertip). The region has one industrial mineral quarry and eight jade operations that were





Fig. 1. Mines, proposed mines, and selected exploration projects, Northwest Region, 2019. Terranes after Nelson et al. (2013).

Provincial Overview of Exploration and Mining in British Columbia, 2019. British Columbia Geological Survey, Information Circular 2020-01

tracked. Placer mining is ongoing, predominantly in the Atlin and Turnagain areas. Numerous aggregate operations supply mainly the local townships throughout the region, although the need for aggregate material has increased significantly because of large LNG projects underway in the Kitimat area and infrastructure upgrades in Prince Rupert.

3.1. Metal mines

The Northwest Region contains three operating metal mines that operated continuously in 2019: **Brucejack**, **Red Chris**, and **Silvertip** (Fig. 1; Table 1).

3.1.1. Brucejack (Pretium Resources Inc.)

The **Brucejack** deposits comprise a high-grade Au-Ag resource in the high alpine approximately 65 km north-northeast of Stewart. The mine is an all-season operation, where 75 km of combined dirt and glacier road access is maintained between highway 37 and the underground mine. The site is powered via a 57 km long transmission line to the BC Hydro power grid and is currently processing at 3800 tpd throughput. For the first three quarters of this year, production totalled 258,168 oz of Au from 929,047 t of ore. All in sustaining costs for the operation in the same time averaged \$895 per ounce of gold sold.

The Valley of the Kings (VOK) zone, which is the current focus of underground mining, is described as a high-grade Au-Ag intermediate-sulphidation epithermal deposit. Syntectonic mineralized veins and stockworks are structurally controlled and crosscut metasedimentary and volcanic rocks of the Hazelton Group. A link between a causative porphyry with epithermal mineralization has not yet been made at Brucejack, although continued deep drilling from underground exposures is ongoing. Deep diamond drilling has continued to extend gold mineralization to depth, and zones of anomalous Cu and Mo have been recognized in conjunction with propylitic alteration.

In May of 2019, Pretium Resources announced updated mineral reserves and resources, where the total is based on both the VOK and West zone. Combined Proven plus Probable reserves were reported at 16 Mt grading 12.6 g/t Au and 59.3 g/t Ag. Total Measured plus Indicated resources were reported at 18.7 Mt grading 14.2 g/t Au and 81.6 g/t Ag, with an additional Inferred resource of 7.8 Mt grading 12.0 g/t Au and 51.3 g/t Ag.

3.1.2. Red Chris (Newcrest Mining Limited 70%; Imperial Metals Corporation 30%)

The **Red Chris** open-pit Cu-Au mine is 17 km east-southeast of Iskut and is accessed by a mine road from highway 37. In August 2019, Newcrest Mining Limited acquired 70% interest in the project for a final purchase price of \$804 million US, creating a joint venture with Imperial Metals Corp. (remaining 30% interest). Production to the end of the third quarter of 2019 totalled 50.2 Mlbs Cu and 24,316 oz Au, with an average daily mill throughput of 28,829 tpd.

The Red Chris Cu-Au deposit is hosted in 203.8 Ma (U-Pb zircon; Rees et al., 2015) diorite-quartz monzonite stocks and dikes that intrude Upper Triassic Stuhini Group rocks. The deposit has recognized sequences of mineralized intrusions (P1-P3), where the main Red stock (P1) represents the largest (6.5 x 1.5 km) and most altered phase and is associated

Mine	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2019 Production (based on Q1- Q3)	Reserves	Resource	Comments
Brucejack	Pretium Resources Inc.	Au, Ag; IS- epithermal; 104B 193	344,200 oz Au	P+Pr: 16 Mt grading 12.6 g/t Au and 59.3 g/t Ag	M+I: 18.7 Mt at 14.2 g/t Au and 81.6 g/t Ag Inf: 7.8 Mt at 12.0 g/t Au and 51.3 g/t Ag	May 2019 updated mineral reserves and resources.
Red Chris	Newcrest Mining Limited (70%), Imperial Metals Corporation (30%)	Cu, Au, Ag; Hybrid calc-alkalic to alkalic porphyry; 104H 005	66.9 Mlbs Cu and 32,400 oz Au	P+Pr: 301.5 Mt at 0.36% Cu, 0.27 g/t Au	2014: M+I: 1.035 Bt at 0.35% Cu, 0.35g/t Au, 1.14g/t Ag Inf: 787.1 Mt at 0.29% Cu, 0.32 g.t Au, 1.04 g/t Ag	August 2019, Newcrest Mining Limited acquired 70% interest creating a joint venture with Imperial Metals Corporation (remaining 30% interest). First three quarters averaged 28,829 tpd.
Silvertip	Coeur Mining Inc.	Ag, Pb, Zn; Manto carbonate- replacement; 104O 038	1,177,300 oz Ag, 17,650,700 lbs Zn, 16,713,300 lbs Pb	P+Pr: 1.61 Mt at 289 g/t Ag, 5.6% Pb, 8.24% Zn	M+I: 1.18 Mt at 222.73 g/t Ag, 4.09% Pb, 8.58% Zn Inf: 0.53Mt at 271.04 g/t Ag, 5.02% Pb, 9.31% Zn	New mineral resource update February 2019. Regional soil sampling and induced polarization survey.

Table 1. Metal mines, Northwest Region.

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

with low-grade mineralization. The P2 stocks and dikes are volumetrically minor although have appreciable Au-Cu grades and are spatially associated with a rheological contact between metasedimentary rocks and overlying Stuhini Group volcanic rocks. Late-stage P3 stocks are lower grade, less altered, and tend to be lower in the system than the Stuhini Group volcanic rocks. Post-mineral mafic dikes cut the main porphyry stock throughout. Previously, Red Chris was recognized as a hybrid-type alkalic porphyry deposit, but Rees et al. (2015) suggested alkalic and calc-alkaline affinities.

As of 2014, open-pit/block cave Measured plus Indicated resources total 1.035 Bt with grades of 0.35% Cu, 0.35g/t Au, and 1.14g/t Ag. Additional Inferred resources total 787.1 Mt with average grades of 0.29% Cu, 0.32 g.t Au, and 1.04 g/t Ag.

3.1.3. Silvertip (Coeur Mining Inc.)

The **Silvertip** Ag-Pb-Zn mine is 8 km south of the British Columbia-Yukon border and 90 km west-southwest of Watson Lake. The mine is accessed via a 25 km-long mine road from Highway 1. The project was acquired by Coeur Mining in 2017 from JDS Silvertip Holdings for \$250 million, and rests on a land package totalling 37,000 ha. In the first three quarters of 2019, the mine produced 174,885 t grading 192.65 g/t Ag, 6.96% Zn, and 4.80% Pb (equitable to 883,055 oz of Ag, 13,237,837 lbs of Zn, and 12,534,228 lbs of Pb).

The Silvertip property is in the Cassiar terrane, and zones of mineralization are generally associated with manto and chimney-style mineralization in basal McDame Group fossiliferous limestones and are capped by overlying Earn Group greywackes and siltstones. The manto-style Ag-Pb-Zn mineralization replaces limestones in the McDame Group, whereas the chimney-style mineralization is reminiscent of structurally controlled brecciated feeder structures. The age of replacement is unknown, but mineralization is thought to be associated with local intrusions dated at 73 Ma (K-Ar biotite; Panteleyev, 1980). A Pb-Zn±Au exhalite deposit is also in overlying siliciclastic rocks of the Earn Group but is not part of an updated mineral resource.

Mining has mainly been conducted at the Silver Creek zone of the mine. Continued development will excavate to depth, enabling extraction from the 65 zone. Regional exploration in 2019 included soil sampling and an induced polarization geophysical survey.

In February 2019, Coeur released updated mineral resources and reserves estimates. The company reported Proven plus Probable reserves of 1.61 Mt grading 289 g/t Ag, 5.6% Pb, and 8.24% Zn. Measured plus Indicated resources were reported at 1.18 Mt grading 222.73 g/t Ag, 4.09% Pb, and 8.58% Zn. Additional Inferred resources were reported at 0.53 Mt grading 271.04 g/t Ag, 5.02% Pb, and 9.31% Zn.

3.2. Coal mines

In 2019, no coal mines operated in the Northwest Region; the **Tenas** project is listed below as a proposed mine.

3.3. Industrial mineral mines and quarries

True-Git Abrasives (Fig. 1; Table 2) is mining the slagheap at the historic **Anyox** site, where slag was created from smelting copper. The slag is mined, cleaned, and barged south where the material is used in making roofing shingles and sand for sand blasting. Mined since 1990, the slagheap represents a successful industrial recycling program.

3.3.1. Nephrite jade

Jade is the informal term for jadeite and nephrite. Jadeite is an aluminum-rich pyroxene, whereas nephrite, the only variety mined in British Columbia, is a rock consisting of fine-grained, interlocking, prismatic amphibole minerals (tremolite-actinolite). British Columbia jade deposits record Permo-Triassic sea-floor ultramafic rocks of Cache Creek terrane altered by high-pressure, relatively low-temperature dynamothermal metamorphic and metasomatic processes (serpentinites). Jade deposits are found both as in situ bedrock and as boulders. In the Northwest Region, these deposits are generally found north and east of Dease Lake (Fig. 1; Table 2).

3.4. Aggregate and industrial rock quarries

The decision was made late in 2018 to move ahead with a \$40 billion LNG project that will see immediate construction of a pipeline from Dawson Creek to Kitimat. Large amounts of aggregate material will be needed to supply construction phases of the project, which will mainly be drawn from the Kitimat and Houston areas in the Northwest Region. The Sandhill pit and quarry and Robinson Lake Trail pit are large sand and gravel and quarrying operations that will fill these needs. Prince Rupert was granted \$153.7 million from the federal government for trade infrastructure projects, where aggregate from the Ridley Island, Kaien Creek, and Rainbow South quarries will be used to upgrade existing transport and utility corridors. Several large aggregate pits and quarries are either now operational or working through the permitting process (Table 2) and are individually expected to produce anywhere from 5000-2,400,000 tpy of aggregate.

4. Placer operations

Placer mining operations have been ongoing in the Northwest Region for more than a century. Operations are concentrated in Atlin and Turnagain areas and to lesser extents north of Dease Lake and areas surrounding Cassiar. Due to the large number of mines and difficulty in obtaining information, these projects are not tracked.

5. Mine development

When a project acquires the necessary permits (Mines Act permit from the Ministry of Energy, Mines and Petroleum Resources and an Environmental Management Act permit from the Ministry of Environment) and secures the working capital to begin mine construction, the mine development stage is reached. There were no mine development projects in the Northwest Region in 2019.

Mine	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2019 Production (based on Q1- Q3)	Reserves	Resource	Comments
Anyox	True-Grit Abrasives	Slag steel	unknown	na	na	Slag is mined, cleaned, and barged for roofing and sand for sand blasting.
Cassiar Jade	Dynasty Jade Ltd.	Nephrite jade; Gems and semi- precious stones; 104P 005	unknown	na	na	Trenching, quarrying, placer production.
Dean Kutcho	Cassiar Jade Contracting Inc.	Nephrite jade; Gems and semi- precious stones; 104I 078	unknown	na	na	Mining.
Jade Valley	United Oriental Mining Ltd.	Nephrite jade; Gems and semi- precious stones;	unknown	na	na	Trenching, quarrying, placer production.
Kaien Creek	Terus Construction Ltd.	Industrial rock; Crushed rock	unknown	na	na	Drilling, blasting, crushing, production for CN Railway and LNG projects.
Kutcho Creek Jade	Continental Jade Ltd.	Nephrite jade; Gems and semi- precious stones; 104I 078	unknown	na	na	Mining and trenching.
Letain	Cassiar Jade Contracting Inc.	Nephrite jade; Gems and semi- precious stones; 104I 079	unknown	na	na	Mining and trenching.
Polar Jade	Glenpark Enterprises Ltd.	Nephrite jade; Gems and semi- precious stones; 104I 083	unknown	na	na	Mining.
Provencher	Glenpark Enterprises Ltd.	Nephrite jade; Gems and semi- precious stones; 104I 092	unknown	na	na	Mining and trenching.
Rainbow Lake South	Spring Creek Aggregates Ltd.	Industrial rock; Crushed rock	unknown	na	na	Drilling, blasting, crushing, production for CN Railway and LNG projects.
Ridley Island	Terus Construction Ltd.	Industrial rock; Crushed rock	unknown	na	na	Drilling, blasting, crushing, production for CN Railway and LNG projects.
Robinson Lake Trail	Haisla & Progressive Ventures Construction Ltd.	Industrial rock; Crushed rock	unknown	na	na	Drilling, blasting, crushing, production for CN Railway and LNG projects.
Sand Hill	Terus Construction Ltd.	Industrial rock; Crushed rock	unknown	na	na	Crushing for CN Railway and LNG projects.
Wolverine	Cassiar Jade Contracting Inc.	Nephrite jade; Gems and semi- precious stones	unknown	na	na	Mining and trenching.

Table 2. Selected industrial mineral mines, quarries and aggregate quarries, Northwest Region.

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6. Proposed mines or quarries

Proposed mines are feasibility-stage projects for which proponents have begun or completed the environmental certification process (generally for late-stage projects) or have submitted or received approvals for Mines Act permits (for projects below British Columbia Environmental Assessment Act thresholds).

6.1. Proposed metal mines

The Northwest Region contains four proposed metal mines (Fig. 1; Table 3). The **Galore Creek**, **KSM**, and **Red Mountain** projects have been granted Environmental Assessment Certification, whereas the **Kutcho** project has begun the environmental assessment process with the Environmental Assessment Office.

6.1.1. Galore Creek (Galore Creek Mining Corporation)

The **Galore Creek** Cu-Au project is operated by the Galore Creek Mining Corporation (GCMC) and is jointly owned between Teck Resources Limited and Newmont Corporation,

 Table 3. Selected proposed metal mines, Northwest Region.

where Newmont Corporation purchased their 50% share in the project in 2018 from NovaGold Canada Inc. At the same time, both owners of GCMC committed to complete a prefeasibility study over the next three to four years to improve overall project understanding and economics. The project is 70 km west of the Bob Quinn airstrip adjacent to highway 37, where a mine access road has been partially constructed.

The deposit is a high-grade, silica-undersaturated, porphyry Cu-Au alkalic system that formed between 210.0 Ma (U-Pb zircon; Micko et al., 2014) and 197.2 Ma (U-Pb titanite; Micko et al., 2014) and intruded Late Triassic Stuhini volcanic rocks. Galore Creek contains thirteen known Cu-Au-Ag mineralized zones and is thought to have formed in two distinct mineralizing events: a northeast-trending main event with volcanic host replacement, and northwest-trending second event that is intrusion and breccia hosted. The main mineralizing event in the Central and Junction zones are spatially and temporally related to a sheeted syenite-monzonite intrusion and hydrothermal breccia body (Micko et al., 2014). Gold-rich mineralization is associated with potassic alteration and disseminated and

Project	Operator (partner)	Commodity; deposit type; MINFILE	Reserves	Resource	Comments
Galore Creek	Galore Creek Mining Corporation (Teck Resources Limited (50%)), Newmont Corporation (50%)	Cu, Au, Ag; Alkaline porphyry; 104G 090	P+Pr: 528 Mt at 0.59% Cu, 0.32 g/t Au, 6.02 g/t Ag	M: 256.8 Mt at 0.72% Cu, 0.36 g/t Au I: 846.7 Mt at 0.39% Cu, 0.23 g/t Au Inf: 198.1 Mt at 0.27% Cu, 0.21 g/t Au	25,000 m of drilling. Metallurgical, geotechnical, resource, and brownfield exploration. Geological mapping, lidar, and stream-sediment sampling.
KSM	Seabridge Gold Inc.	Cu, Au, Ag, Mo; Calc-alkaline porphyry; 104B 191	P+Pr: 2.198 Bt at 0.55 g/t Au, 0.21% Cu, 2.6 g/t Ag, 42.6 g/t Mo	M+I: 2.902 Bt at 0.54 g/t Au, 0.21% Cu, 2.7 g/t Ag, 44 g/t Mo Inf: 2.719 Bt at 0.35 g/t Au, 0.32% Cu, 2.0 g/t Ag, 29 g/t Mo (Total for KSM deposits)	Exploration work to evaluate potential for additional Au-Cu porphyry systems below the Sulphurets thrust fault, follow up high-grade epithermal gold mineralization in the Sulphurets deposit, and expand the Sulphurets resource estimate.
Kutcho	Kutcho Copper Corp.	Cu, Pb, Zn; Noranda/Kuroko VMS; 104I 060	Pr: 10.4 Mt at 2.01% Cu, 3.19% Zn, 0.37 g/t Au, 34.61 g/t Ag	M+I: 17.26 Mt at 1.85% Cu, 2.72% Zn, 0.49 g/t Au, 33.9 g/t Ag	Mineralogical study to determine the variability and abundance of copper sulfide minerals.
Red Mountain	Ascot Resources Ltd.	Au, Ag; Subvolcanic and precious metal veins; 103P 086	P+Pr: 1.95 Mt at 7.53 g/t Au, 21.9 g/t Ag	M+I: 3.19 Mt at 7.63 g/t Au, 21.02 g/t Ag Inf: 0.41 Mt at 5.32 g/t Au, 7.33 g/t Ag	March 2019: Ascot purchased the project from IDM Mining for \$45 million.

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

replacement-style bornite-chalcopyrite-pyrite mineralization, where Au may be hosted in bornite.

In 2019, approximately 25,000 m of drilling was conducted on the property, focussing on resource and metallurgical drilling in the deposit area to improve orebody knowledge. In addition, brownfield exploratory drilling tested prospective targets adjacent to the deposit, and geotechnical drilling was completed in the deposit area and elsewhere on the property, focussing on infrastructure and access locations. Geological mapping, in conjunction with lidar and stream-sediment sampling, was conducted to better understand the geology and structural controls of mineralization. Environmental work, including baseline water testing, wildlife studies, and hydrogeological studies are ongoing.

The Galore Creek project contains a Measured resource of 256.8 Mt grading 0.72% Cu, 0.36 g/t Au, an Indicated resource of 846.7 Mt at 0.39% Cu, 0.23 g/t Au with an additional Inferred resource of 198.1 Mt grading 0.27% Cu, 0.21 g/t Au (Teck Resources Limited, 2019).

6.1.2. Kutcho (Kutcho Copper Corp.)

The Kutcho property is approximately 100 km east of Dease Lake and the site is accessible via a gravel airstrip about 10 km from the deposit. The shallowly dipping Kuroko-type VMS deposit has three zones in a narrow belt of Permian-Triassic volcanic rocks and Jurassic sedimentary rocks between the Nahlin fault and the King Salmon fault. Mineralization in the footwall is pyritic, with zoned Cu-Zn mineralization. A metallurgical program is underway, using a mineralogical study to determine the variability and abundance of Cu-sulphide minerals, and will be used in the feasibility study. The company entered the environmental assessment and permitting process in September 2019. The deposit has Probable reserves of 10.4 Mt grading 2.01% Cu, 3.19% Zn, 0.37 g/t Au and 34.61 g/t Ag, with a Measured plus Indicated resource of 17.26 Mt at 1.85% Cu, 2.72% Zn, 0.49 g/t Au, 33.9 g/t Ag. The average annual production is expected to be 33 Mlbs of Cu and 42 Mlbs of Zn.

6.1.3. KSM (Seabridge Gold Inc.)

The **KSM** project consists of four porphyry Cu-Au deposits: Kerr, Sulphurets, Mitchell, and Iron Cap. These deposits are on the western boundary of the Brucejack mineral claims and access is via helicopter. The focus of exploration work in 2019 was to evaluate potential for additional porphyry Au-Cu systems below the Sulphurets thrust fault, follow up high-grade epithermal Au mineralization in the Sulphurets deposit, and expand on the Sulphurets resource estimate. Seabridge received provincial and federal Environmental Assessment approval in 2014, which was extended to 2024 early in 2019.

KSM includes a cluster of deposits in the Stikine volcanic arc terrane, where calc-alkaline porphyry mineralization occurred in four phases and is related to the hypabyssal, diorite-monzodiorite Mitchell intrusions (196-190 Ma; Febbo et al., 2015, 2019). This island arc tholeiite series of stocks and dikes intruded Late Triassic-Early Jurassic sedimentary and volcanic

rocks of the Stuhini and Hazelton groups. Mineralization is disseminated in clustered quartz-vein stockworks and sheeted quartz veinlet arrays as fine-grained chalcopyrite, bornite, molybdenite, and pyrite. The geological setting was complicated by mid-Cretaceous deformation related to the formation of the Skeena fold belt. All the KSM deposits are open at depth.

The KSM deposits may represent one of the largest undeveloped Cu-Au camps in the world (by reserves), where the total KSM Proven plus Probable reserve estimate is 2.198 Bt grading 0.55 g/t Au, 0.21% Cu, 2.6 g/t Ag, and 42.6 g/t Mo. The total KSM Measured plus Indicated mineral resource was reported at 2.902 Bt grading 0.54 g.t Au, 0.21% Cu, 2.7 g/t Ag, and 44 g/t Mo, and additional Inferred resource of 2.719 Bt grading 0.35 g/t Au, 0.32% Cu, 2.0 g/t Ag, and 29 g/t Mo.

6.1.4. Red Mountain (Ascot Resources Ltd.)

The **Red Mountain** gold project is a proposed high-grade underground mine 15 km northeast of the town of Stewart. In March of this year Ascot Resources completed the acquisition of the 17,125 ha Red Mountain project from IDM Mining, who received its Environmental Assessment Certificate in October of 2018. Ascot purchased the Red Mountain project for \$45 million and the project has an estimated capital development cost of approximately \$145 million. Since the acquisition, Red Mountain has been on care and maintenance, although the new owner envisions bulk underground mining methods with Au-Ag dore produced onsite. Early in 2019, Ascot Resources and the Nisga'a Nation signed a benefits agreement for the Red Mountain project.

Mineralization is contained in quartz-calcite veins and vein stockworks with northwesterly trends and moderate to steep southwesterly dips. Gold occurs in its native form, electrum, and a variety of gold-bearing tellurides; sulfosalts are also present. Pyrite is the predominant sulphide, although pyrrhotite occurs locally. Disseminated pyrite and pyrrhotite alteration may also surround stockwork zones.

In 2019, Ascot Resources published a mineral resource estimate that built on the estimate IDM published in 2016. Forty drill holes completed late in 2018 increased the gold resource by 200,000 oz and the Measured plus Indicated resources are now reported at 3.19 Mt grading 7.63 g/t Au and 21.02 g/t Ag, with an additional Inferred resource of 0.41 Mt grading 5.32 g/t Au and 7.33 g/t Ag. In 2017, a Proven plus Probable reserve of 1.95 Mt at 7.53 g/t Au, 21.9 g/t Ag was reported.

6.2. Proposed coal mines

There is currently one proposed coal mine, Allegiance Coal Limited's **Tenas** project (Fig 1.; Table 4).

6.2.1. Tenas (Allegiance Coal Ltd. 95%; Itochu Corp. 5%)

Telkwa Coal Ltd., a subsidiary of Allegiance Coal Ltd., is proposing to develop the **Tenas** project, which is 25 km south of Smithers and 7 km southwest of the community of Telkwa. The Telkwa coalfield produced 433,000 t of thermal coal

Project	Operator (partner)	Commodity; deposit type; MINFILE	Reserves	Resource	Comments
Tenas	Allegiance Coal Ltd. (95%), Itochu Corp. (5%)	Coal; Metallurgical coal; 093L 156	P+Pr: 62.9 Mt coal	na	Entered provincial Environmental Assessment process in November of 2018 estimated to produce approximately 775,000-825,000 t of steelmaking-coal annually with a mine- life of ~25 years.

Table 4. Selected proposed coal mines, Northwest Region.

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

from rocks of the Skeena Group (Early Cretaceous) between 1918 and 1970. Currently there are four separate pits on approximately 1050 ha, where the current focus is the Tenas pit. The project entered the provincial Environmental Assessment process last November and the project is estimated to produce approximately 775,000-825,000 t of steelmaking coal annually with a mine-life of about 25 years. In 2017, Allegiance Coal Ltd. released a reserve estimate of Proven plus Probable reserves of 62.9 Mt of coal.

In 2019, 47 drill holes were completed to obtain additional coal quality and geotechnical information, and 600 m of sonic drilling was completed for geotechnical design and proposed waste-rock locations. Additional groundwater monitoring wells were installed throughout the property.

7. Selected exploration activities and highlights

Exploration projects are described on a continuum from early to advanced stages. Early-stage operations are generally defined as grassroots operations that collect rock and soil samples for geochemical analysis, usually combined with regional mapping and ground- or air-based geophysical surveys. This initial geological and geophysical testing may be done on sample grids, where the purpose is to generate targets to further test, usually by drilling. At early stages it is a common to establish base-line environmental testing and engage with communities and First Nations regarding the project direction. At advancedstage operations, a mineral resource has been delineated by drilling. Later stages of exploration will generally coincide with mine-evaluation and feasibility studies, which involve environmental, social, engineering, and financial consideration to properly evaluate a proposed mine.

7.1. Selected precious metal projects

The Northwest Region is host to many precious metal projects (Fig. 1; Table 5), with a large concentration of projects in the area commonly referred to as the Golden Triangle.

7.1.1. Atlin Gold (Brixton Metals Corp.)

The **Atlin Gold** project includes a 933 km² area near Atlin. Mesothermal-style mineralization is structurally controlled, and new geophysical data from vertical-gradient magnetic surveys highlight several structures that could potentially control gold mineralization. Exploration work in 2019 included 1618 m of drilling in 22 holes at the Pictou and LD showings, a 1965 linekm magnetic geophysical survey, and soil and rock sampling. Results from drilling included gold mineralization in 13 of 22 holes, where highlights were 8.53 g/t Au across 2 m. A rock grab sample from Union Mountain returned 45 g/t Au.

7.1.2. Cassiar Gold (Margaux Resources Ltd.)

Margaux Resources and Wildsky Resources entered into an agreement for Margaux Resources to acquire 100% interest in the **Cassiar Gold** project early in 2019. Historic gold production on the property was approximately 350,000 oz at an average grade of 11.9 g/t Au, and about 275,000 m of historical drilling was conducted on the property. Orogenic-style mineralization is found predominantly in basalt-hosted low-sulphide gold-bearing shear veins intimately related to regional faults. Shear veins are generally steeply dipping and <2 m wide, but widths range from a few cm to about 10 m. In September 2019, after a review of historical data, Margaux announced an updated Inferred resource estimate for the Taurus deposit at 21.83 Mt grading 1.43 g/t Au with a 0.7 g/t Au cut-off. The company is compiling and analyzing data and furthering its economic assessment with more field work.

7.1.3. Clone Gold (Teuton Resources Corp. 75%; Silver Grail Resources Ltd. 25%)

In November, Sky Gold Corp. dropped the option for the **Clone Gold** project, and Teuton now owns 75% interest, with Silver Grail Resources owning the remaining 25%. The property is 20 km southeast of Stewart and contains gold and gold-copper mineralization in a series of sub-parallel shears along a 500 m strike length. In 2019, before dropping the option, Sky Gold drilled 811 m, which was designed to confirm historical results and test new areas. Drill highlights included 124.6 g/t Au across 4.1 m in the Main "H" zone, which has known mineralization extending along a 300 m strike length.

7.1.4. Engineer (Engineer Gold Mines Ltd.)

Centered on the historic Engineer Gold mine the 14,020 ha **Engineer** project is 32 km southwest of Atlin. Dewatering of existing underground workings was completed in 2019, which will provide exploration access to Shear zone A, Jersey Lilly,

Tombe

Project	Operator (partner)	Commodity; Deposit type; MINFILE	Resource (NI 43-101 compliant unless indicated otherwise)	Comments
Atlin Gold	Brixton Metals Corporation	Au; Hydrothermal precious metal veins; 104N 043	na	1695 line-km magnetic survey; 1618 m of drilling with highlights of 8.53 g/t Au across 2 m and a grab sample returned 45 g/t Au.
Ball Creek	Golden Ridge Resources Ltd. (80%), Evrim Resources Corp. (20%)	Cu, Au; Porphyry; 104G 072	na	Soil sampling, geological mapping, and prospecting identified new mineralized targets. 1095 m of deep diamond drilling to test the southwest extension of Main zone; drilling at Goat zone. Highlights at Main zone: 291.5 m at 0.14% Cu, 0.48 g/t Au, and 0.95 g/t Ag.
Big Red	Libero Copper & Gold Corporation	Cu, Au; Porphyry	na	588 m of drilling.
Brucejack Regional	Pretium Resources Inc.	Au, Cu, Pb, Zn; Epithermal vein and VMS	na	15,000 m of drilling at regional Brucejack prospects. Regional grassroots sampling, mapping, prospecting, geophysics, and hyperspectral mapping. Drill highlights from the A6 zone included 1.5 m grading 2890 g/t Ag and 1.81% Cu.
Cassiar Gold	Margaux Resources Ltd.	Au; Precious metal veins; 104P 012	Inf: 21.83 Mt at 1.43 g/t Au (0.7 g/t Au cut-off)	Compilation and data analysis.
Castle	Colorado Resources Ltd.	Cu, Au, Ag; Porphyry and precious metal veins	na	Coincident gold and copper anomalies from sampling chargeability anomalies over East Castle zone; 1555 m drilling as follow up.
Clone Gold	Teuton Resources Corp. (75%) , Silver Grail Resources Ltd. (25%)	Au, Ag, Pb, Zn: LS-epithermal and polymetallic veins; 103P 251	na	In November, Sky Gold Corp. dropped the option for Clone Gold; Teuton Resources Inc. now owns 75% interest and Silver Grail Resources owns 25%. Drilling of 811 m to confirm historical results and test new areas. Highlights of 124.6 g/t Au across 4.1 m in the Main "H" zone.
Del Norte	Teuton Resources Corp.	Ag, Zn, Pb; Polymetallic; 104A 176	na	Four drill holes drilled following up on a 2018 ZTEM survey.
Dolly Varden	Dolly Varden Silver Corporation	Cu, Pb, Zn, Ag, Au; Kuroko VMS with polymetallic veins; 103P 188	I: 3.42 Mt at 299.8 g/t Ag Inf: 1.29 Mt at 277.0 g/t Ag	Preliminary metallurgical testing, 11,000 m of drilling, geochemical sampling, prospecting and geological mapping. Highlights at Chance target of 15.20 m grading 488.3 g/t Ag, 0.55% Pb, and 0.05% Zn in a previously unknown offset of the Chance vein.

 Table 5. Selected exploration projects, Northwest Region.

Table 5. Continued.

Dunwell	American Creek Resources Ltd.	Au, Ag, Pb, Zn; Polymetallic veins; 103P 052	na	2000 m was drilled to test multiple targets.
Engineer	Engineer Gold Mines Ltd.	Au, Ag; LS-epithermal; 104M 014	Inf: 41,000 t at 19.0 g/t Au	3000 m of surface and underground drilling. Historic channel sample highlights from the Double Decker vein returned 38.03 g/t Au across 24.7 m.
Eskay Creek	Skeena Resources Limited	Au, Ag, Cu, Pb, Zn; VMS and precious metal veins; 104B 008	I: 12.65 Mt at 4.3 g/t Au, 110 g/t Ag (pit constrained) Inf: 14.42 Mt at 2.3 g/t Au, 47 g/t Ag (pit constrained) I: 819,000 t at 6.4 g/t Au, 139 g/t Ag (underground) Inf: 295,000 t at 7.1 g/t Au, 82 g/t Ag (underground)	Drilling in 2019 focussed on upgrading areas of Inferred resources into Indicated category; highlights include 312.81 g/t Au and 95 g/t Ag across 2.21 m, and separately 6.75 g/t Au and 285 g/t Ag across 27.50 m.
Forrest Kerr	Aben Resources Ltd.	Au, Ag, Cu; Precious metal veins	na	9600 m drilled in 25 holes; highlights include a 16 m interval grading 2.22 g/t Au, 2.39 Ag, and 0.31% Cu.
Golddigger	Goliath Resources Limited	Au, Cu, Pb, Zn; Polymetallic veins	na	Field reconnaissance to follow- up targets generated via lidar and geochemical sampling. Most chip samples (30) from Sure Bet zone returned assays >1.4 g/t Au. A single channel sample was assayed at 8.4 m of 7.37 g/t Au, including 3.4 m of 17.68 g/t Au.
Hank	Golden Ridge Resources Ltd.	Cu, Au; Calc-alkaline porphyry	na	2952 m of drilling with highlights at the Williams zone including 278 m grading 0.35% Cu, 0.28 g/t Au, and 1.71 g/t Ag.
Hat	Doubleview Capital Corp.	Cu, Au; Alkalic porphyry	na	Drilling to test deep IP anomalies at the Lisle deposit.
Iskut	Seabridge Gold Inc.	Cu, Au; Porphyry	na	IP surveys, surface geochemical sampling, and detailed mapping to follow up the initial diatreme discovery in 2018. The geophysical footprint was expanded to the south and southwest and was shown to plunge to the south.
Kirkham	Metallis Resources Inc.	Cu, Au; Porphyry	na	4000 m of diamond drilling followed-up gold-rich targets at the Cole-Etta zone, where porphyry- style mineralization was previously recognized.
Nickel Mountain	Garibaldi Resources Corp.	Ni, Cu, Co, Pt, Pd, Au; Tholeiitic intrusion hosted; 104B 006	na	25,000 m of drilling; highlights include 18.2 m grading 7.04% Ni and 3.81% Cu in a broader zone of mineralization of 86.5 m grading 1.88% Ni and 1.32% Cu.
Lucky Strike	Goliath Resources Limited	Cu, Au, Mo; Calc-alkaline porphyry	na	Three drill holes totalling 1741 m following up on gold-bearing chalcopyrite and molybdenum stockwork mineralization discovered in 2018.

Table 5. Continued.

McBride	Hawkeye Gold and Diamond Inc.	Cu, Au; Porphyry	na	An IP survey identified two separate chargeability anomalies, one of which was drilled (703 m).
Midas	Juggernaut Exploration Ltd.	Ag, Cu, Ag; Polymetallic veins; 103I 131	na	Nine holes totalling 2548 m.
Pitman	Casa Minerals Inc.	Cu, Au, Zn, Pb, Mo; Polymetallic and porphyry; 1031 046	na	2037 m of drilling on the Golden Dragon and Dragon Tale zones.
Premier/Dilworth	Ascot Resources Ltd.	Au, Ag, Cu; LS-epithermal, polymetallic veins; 104B 054	I: 2.78 Mt at 7.46 g/t Au and 26.2 g/t Ag (Premier, Northern Lights, Big Missouri, Silver Coin, and Martha Ellen deposits)	>50,000 m of drilling; highlights included 24.45 g/t Au across 8.43 m.
Rock and Roll	Etruscus Resources Corp.	Cu, Zn, Pb, Au; Besshi VMS and intrusion-related precious metal veins; 104B 377	Inf: 2.02 Mt at 0.71 g//t Au, 87.1 g/t Ag, 0.23% Cu, 0.23% Pb, 0.98% Zn	Biogeochemical orientation survey for Au, Ag, Ba, Cu, Fe, Hg, Pb, Se, Zn in tree bark samples; 2500 m of diamond drilling.
Scottie Gold Mine	Scottie Resources Corp.	Au, Ag, Cu: Intrusion-related and polymetallic veins; 104B 034	na	Geochemical surface sampling and 2050 m of drilling on Bow property. Drilling in areas recently exposed from glacier retreat. A grab sample at the Domino zone produced 536 g/t Au and 735 g/t Ag.
Schaft Creek	Teck Resources Limited (75%) , Copper Fox Minerals Inc. (25%)	Cu, Mo, Au; Porphyry; 104G 015	M+I: 1.23 Bt at 0.26% Cu, 0.017% Mo, 0.19 g/t Au, 1.69 g/t Ag Inf: 597.2 Mt at 0.22% Cu, 0.016% Mo, 0.17 g/t Au, 1.65 g/t Ag	Continued environmental studies and infrastructure work.
Silver Coin	Ascot Resources Ltd.	Au, Ag, Cu, Zn, Pb; LS-epithermal and polymetallic veins; 104B 095	I: 0.70 Mt at 4.46 g/t Au and 17.9 g/t Ag Inf: 0.97 Mt at 4.39 g/t Au and 19.0 g/t Ag	10,500 m of drilling; highlights include 52.67 g/t Au across 3.59 m.
Silver Queen	Equity Metals Corporation	Ag, Pb, Zn, Au; Transitional porphyry- epithermal; 093L 002	I: 0.815 Mt at 6.35% Zn, 3.24 g/t Au, 201.4 g/t Ag, 0.26% Cu, 0.96% Pb Inf: 0.801 Mt at 5.21% Zn, 2.49 g/t Au, 184.3 g/t Ag, 0.31% Cu, 0.88% Pb (resources at NSR cut-off of C\$100/t)	New Nadina Explorations changed its name to Equity Metals Corp. In August, a mineral resource estimate was released.
Snip	Skeena Resources Ltd.	Au, Ag; Intrusion-related, mesothermal; 104B 250	na	Surface drilling in 10 holes totalling 1934 m; highlight of 1131.91 g/t Au across 1.5 m.

Table 5. Continued.				
Tatogga; Saddle North	GT Gold Corp.	Cu, Au, Ag; Porphyry; 104G 432	na	Continued to expand mineralization to depth and along trend. Recent drilling has also identified high-grade precious metal veins peripheral to the main body of porphyry mineralization including highlights of 4.11 m of 25.42 g/t Au and 15.70 m of 6.21 g/t Au. Newmont Corporation invested \$25.9M. Resource estimate and economic evaluation expected first quarter 2020.
Tatogga; Saddle South	GT Gold Corp.	Au, Ag; IS-epithermal; 104G 433	na	Drill highlights from the final holes of the 2018 season include 18.08 g/t Au and 313.38 g/t Ag across 2.13 m and 8.15 g/t Au and 5.40 g/t Ag across 5.85 m, which extended the epithermal system.
Thorn	Brixton Metals Corporation	Ag, Au, Cu, Zn, Pb; Subvolcanic; 104K 031	I: 7.4 Mt at 35.54 g/t Ag, 0.51 g/t Au, 0.13% Cu, 0.32% Pb, 0.59% Zn	Geological mapping and soil-rock geochemistry at the Chivas zone. An induced polarization-magnetotelluric survey showing a chargeability high over Oban zone. Drill highlights at Oban zone returned 554 m of 0.57 g/t Au, 0.24% Cu, 43 g/t Ag, 0.55% Zn, and 0.28% Pb.
Todd Creek	ArcWest Exploration Inc.	Cu, Au, Pb, Zn; Porphyry, volcanogenic, hydrothermal; 104A 001	na	After sampling of VMS East zone, a 900 m overall strike length of mineralization has been recognized. 400 m to the west of VMS East zone a newly discovered zone of outcropping VMS mineralization was traced across 400 m N-S. Grab samples form this zone (VMS West) with assays of 2.05 g/t Au and 1.21% Cu.
Treaty Creek	Tudor Gold Corp. (60%), Teuton Resources Corp. (20%), American Creek Resources Ltd. (20%)	Cu, Au; Porphyry; 104A 004	na	Drilling at the Goldstorm zone, totalling 9780 m in 14 diamond drill holes, returned highlights of 2.006 g/t Au across 87 m, in an interval of 336 m averaging 1.004 g/t Au.
Turnagain	Giga Metals Corporation	Ni, Co, Pt, Cu, Mo; Alaskan-type, magmatic; 104I 014	M+I: 1.073 Bt at 0.220% Ni and 0.013% Co Inf: 1.142 Bt at 0.217% Ni and 0.013% Co	Updated resource in September 2019 based on 36 infill holes totalling 8940 m drilled in 2018. A preliminary economic assessment (PEA) is expected in 2020.
Willoughby	Strikepoint Gold Inc.	Au, Ag, Zn, Pb; Precious and polymetallic veins; 103P 006	na	Hand-trenching and channel sampling; 2000 m of diamond drilling. North zone highlights of 26.28 g/t Au and 95.00 g/t Ag across 4.0 m; surface sampling near the Wilkie zone returned a grab sample of 67.3 g/t Au and 164.0 g/t Ag.

M = Measured; I = Indicated; Inf = Inferred

Double Decker, and Engineer veins on one of the mine levels. Dewatering will also allow for test mining and bulk sampling. A 3000 m surface and underground drill program was conducted, targeting near-mine veins and bulk-tonnage shear and intrusivehosted gold targets. Historic channel sample highlights from the Double Decker vein returned 38.03 g/t Au across 24.7 m.

7.1.5. Forrest Kerr (Aben Resources Ltd.)

Since 2016, the Boundary zone has been the focus of Aben Resources at the **Forrest Kerr** project. Earlier this year an airborne magnetic survey was completed over the entire Boundary zone to delineate the subsurface geology and put into context high-grade gold mineralization discovered previously (2018 drill highlights of 62.4 g/t Au across 6.0 m). In 2019, 9600 m of core drilled in 25 drill holes focussed on testing the North Boundary zone and encountered precious and polymetallic mineralization in shear zones cutting Hazelton Group volcanic and subvolcanic rocks and spatially coincident with magnetic anomalies. Drill highlights included a 16 m interval grading 2.22 g/t Au, 2.39 Ag, and 0.31% Cu.

7.1.6. Premier/Dilworth (Ascot Resources Ltd.)

Approximately 20 km northeast of Stewart, the Premier project is Ascot Resource's flagship operation. About 628,000 m of previous drilling primarily targeted the Premier mine, the Big Missouri mine, Martha Ellen, and the Dilworth zones. Drilling in 2019 was designed to test exploration targets delineated from geophysical work in 2018 and to upgrade and expand resources in known zones of mineralization. By the end of the year more than 52,000 m of drilling was completed; a highlight included 24.45 g/t Au across 8.43 m. Precious metal mineralization in the area is thought to have been magmatically derived and is spatially associated with the Texas Creek plutonic suite. Mineralized quartz-calcite veins, vein stockwork, and hydrothermal breccia systems cut volcanic and sedimentary rocks of the Hazelton Group. The Premier, Northern Lights, Big Missouri, Silver Coin, and Martha Ellen deposits contain an Indicated resource of 2.78 Mt grading 7.46 g/t Au and 26.2 g/t Ag.

7.1.7. Scottie Gold Mine (Scottie Resources Corp.)

The **Scottie Gold Mine** project is operated by Scottie Resources, who changed their name from Rotation Minerals Ltd. early in 2019. The property hosts the past-producing Scottie Gold mine which produced 95,400 oz of gold. Mineralization consists of gold-bearing quartz-calcite sulphide veins that appear to be coeval with sub-parallel shear and fracture zones of the Texas Creek suite, specifically the Summit Lake pluton. In 2019 the company began surface geochemical sampling, completed 2050 m of diamond drilling, followed up on near-surface historic high-grade mineralization on the newly acquired Bow property, and explored recently deglaciated outcrops. The Domino zone, which is 1.9 km west of the past-producing Scottie Gold mine, produced assay results from grab samples of 536 g/t Au and 735 g/t Ag and a chip sample

returned 10.5 g/t Au and 14 g/t Ag across 5.3 m. The Domino zone consists of several discrete 200 m wide shear structures that continue parallel for more than 700 m along strike.

7.1.8. Silver Coin (Ascot Resources Ltd.)

Ascot Resources acquired **Silver Coin** late in 2018. The deposit hosts similar host rocks and ore minerology to that of Premier and Big Missouri. Silver Coin contains existing underground infrastructure and central parts of the deposit are drilled sufficiency to warrant resources being classified in the Indicated category. The 10,500 m drill program this year was designed to infill and provide geotechnical context. Drilling highlights include 52.67 g/t Au across 3.59 m. An Indicated mineral resource is reported at 0.70 Mt grading 4.46 g/t Au and 17.9 g/t Ag with an additional Inferred resource of 0.97 Mt grading 4.39 g/t Au and 19.0 g/t Ag.

7.1.9. Snip (Skeena Resources Limited)

The Snip mine produced approximately 1 Moz of gold from 1991 to 1999. Skeena Resources Limited acquired 100% interest in the project from Barrick Gold in 2017. Late in 2018, Skeena optioned the property and received an investment from Hochschild Mining Holdings Ltd, where nearly \$7 million was generated giving Hochschild 8.3% of Skeena's total issued and outstanding shares. In addition, Hochschild may earn 60% interest in the Snip project by spending twice the amount Skeena has spent since its original option from Barrick. Since the original acquisition from Barrick, Skeena Resources has reviewed and modelled more than 280,000 m of historical drill data. Surface drilling in 2019 in 10 holes totalling 1934 m and intersected 1131.91 g/t Au across 1.5 m. The Snip deposit is in the Bronson structural corridor and the southwest-dipping shear-vein system is hosted within Upper Triassic Stuhini Group metasedimentary rocks that are cut by Early Jurassic stocks and plutons.

7.1.10. Tatogga (Saddle South; GT Gold Corp.)

The **Tatogga** project is approximately 14 km west of the Red Chris mine, where access to site is via helicopter from Iskut. The Saddle South zone is characterized as an intermediateepithermal deposit. Mineralization in the highest grade sections contains pyrite and subordinate sphalerite, galena, chalcopyrite, and trace sulphosalts in semi-massive quartz-calcite sulphide veins and vein breccias. Drill highlights from the final holes of the 2018 season and released in 2019 include 18.08 g/t Au and 313.38 g/t Ag across 2.13 m and 8.15 g/t Au and 5.40 g/t Ag across 5.85 m, which extended the epithermal system originally discovered in 2017 along strike by several 100 m. With the discovery of the adjacent Cu-Au porphyry deposit at Saddle North in 2018, exploration efforts have shifted to this zone.

7.1.11. Willoughby (Strikepoint Gold Inc.)

Strikepoint Gold acquisitioned the **Willoughby** project in 2019 from ArcWest Exploration. The project is adjacent to Ascot's Red Mountain project and is approximately 30 km east

of Stewart. The property has 4625 m of historic drilling on six zones and contains underground workings excavated in the 1990s. Gold-silver mineralization is in Early Jurassic volcanic and sedimentary rocks and is thought to be associated with the 'Goldslide suite' intrusive complex. In 2019, hand-trenching and channel sampling was conducted along with about 2000 m of diamond drilling. Drilling at the North zone produced highlights of 26.28 g/t Au and 95.00 g/t Ag across 4.0 m, and surface sampling near the Wilkie zone returned a grab sample of 67.3 g/t Au and 164.0 g/t Ag.

7.2. Selected porphyry projects

The Northwest Region hosts many significant porphyry projects (Fig. 1; Table 5), and the region is highly prospective for Au-Cu-Mo bulk-tonnage mineralization related to Triassic-Jurassic island arc accretion to the western margin of ancestral North America and post accretionary intrusive complexes.

7.2.1. Ball Creek (Golden Ridge Resources Ltd. 80%; Evrim Resources Corp. 20%)

The **Ball Creek** project was optioned from Evrim Resources in July 2019 for 80% interest in the 52,442-hecratre property, which fully surrounds the Hank property. The Ball Creek property contains seven porphyry gold-copper targets and four epithermal gold-silver targets. Exploration in 2019 included collecting more than 4500 soil samples, geological mapping, and prospecting, which identified new mineralized targets. Approximately 1095 m of deep diamond drilling was completed to test the southwest extension of the Main zone, and drilling at Goat zone was also done. The first drill hole testing the southwest extension of the Main zone intersected a feldspar-hornblende±biotite porphyry containing localized potassic alteration and copper mineralization. This drill hole added 60 m of strike to the known mineralization at the Main zone. Drill highlights included 291.5 m at 0.14% Cu, 0.48 g/t Au, and 0.95 g/t Ag.

7.2.2. Big Red (Libero Copper & Gold Corporation)

The **Big Red** project is 45 km southwest of Telegraph Creek and is accessible by road. Copper-gold-molybdenum anomalies are centered on a magnetic high that is coincident with a radiometric potassic anomaly and spatially associated with a Jurassic porphyritic intrusion. A five-year exploration permit for geophysics and drilling was granted to the company in September, and drilling was completed on the Copper Bowl porphyry Au-Cu target. A total of 588 m was drilled, and mineralization appears to be associated with quartz and pyrite and banded calcite-chlorite veins. Geochemical sampling was also completed in 2019 and new targets have been delineated at the northern extent of the Copper Bowl target and the Terry target.

7.2.3. Castle (Colorado Resources Ltd.)

The **Castle** property (formerly known as the Kinaskan-Castle) adjoins the GT Gold property of Tatogga and is the target of potential porphyry Cu-Au and high-grade precious metal veins. Previous work included high-resolution aeromagnetic and radiometric surveys, soil and rock sampling, geological field mapping, and a recent IP survey. Late in 2019, 1555 m of drilling was conducted at the East Castle zone targeting coincident gold and copper anomalies (detected from sampling) and chargeability anomalies.

7.2.4. Hank (Golden Ridge Resources Ltd.)

The **Hank** property contains epithermal-style (Boiling and Creek zones) and porphyry-style mineralization (Williams zone). Drilling of 2952 m in 2019 was used to test the continuation of mineralization at depth and to the northeast at the Williams zone. Highlights from drilling included 278 m of potassic altered monzonite and Stuhini Group rocks grading 0.35% Cu, 0.28 g/t Au, and 1.71 g/t Ag. Other drilling tested the Boiling and Creek zones. Previous work at these zones produced drill highlights of 20 m grading 11.63 g/t Au, and 6.8 g/t Ag, but no significant drill intersections were encountered in follow-up work.

7.2.5. Hat (Doubleview Capital Corp.)

The Lisle zone at the **Hat** project is an alkalic porphyry Au-Cu deposit that was discovered by drilling in 2014. Sulphide mineralization (primarily chalcopyrite) is in fractured quartzfilled stockworks in dioritic intrusive rocks and highly altered Upper Triassic volcanic and volcaniclastic andesites. Drilling in 2019 tested deep IP anomalies at in the Lisle deposit.

7.2.6. Iskut (Seabridge Gold Inc.)

The **Iskut** property includes the former Johnny Mountain gold mine and the Bronson Slope copper-gold deposit. In 2018, Seabridge drilled 2700 m into the Quartz Rise lithocap focussing on high-grade epithermal precious metal occurrences. This drilling discovered a diatreme containing clasts of veined diorite porphyry with copper-gold mineralization. In 2019, this discovery was following up on with IP surveys, surface geochemical sampling, and detailed mapping. The geophysical footprint was expanded to the south and southwest and was shown to plunge to the south.

7.2.7. Kirkham (Cole-Etta; Metallis Resources Inc.)

Near the Eskay Creek mine, the **Kirkham** project is a grassroots property with potential for porphyry Au-Cu, precious metal vein, and Ni sulphide deposits. In 2018, high-resolution VTEM and satellite imagery surveys were completed. A series of coincident conductive and magnetic targets were identified from this work. In 2019, Metallis Resources drilled approximately 4000 m to follow up gold targets at the Cole-Etta zone, where porphyry-style mineralization was previously recognized.

7.2.8. Lucky Strike (Goliath Resources Limited)

The **Lucky Strike** property is 40 km north of Terrace, in the Skeena arch. At the Lorne Creek zone, mineralization is defined

by a 1200 by 700 m alteration system. Bedrock sampling of surface stockworks and veins at surface in 2018 found goldbearing chalcopyrite and molybdenum-bearing stockwork mineralization that is coincident with phyllic alteration of a monzonite porphyry. In 2019, follow-up drilling in three holes totalling 1741 m intersected a pyritic alteration zone with potassic alteration.

7.2.9. McBride (Hawkeye Gold and Diamond Inc.)

Hawkeye's **McBride** property is about 12 km north of the Red Chris mine. Previous work included mapping and grassroots soil, stream, and rock sampling to identify porphyry Cu-Au targets. Exploration in 2019 included a ground-based IP survey, which identified two separate chargeability anomalies in the northern and western parts of the property. The northern anomaly encompasses a 2 km long trend with geochemical anomalies indicated by grab sample assays with up to 5.18 g/t Au and 1.89% Cu. The western anomaly was tested by diamond drilling in 2019 and 703 m of core was produced.

7.2.10. Shaft Creek (Teck Resources Limited 75%; Copper Fox Minerals Inc. 25%)

The **Schaft Creek** project is managed through the Schaft Creek Joint Venture (SCJV), where Teck Resources is the operator and holds a 75% interest, while Copper Fox Metals holds the remaining 25%. In 2019, the SCJV continued environmental studies and revisions to key infrastructure at the main camp. Work is ongoing to complete technical and engineering improvements to reduce capital and operating costs associated with the 133 ktpy mine plan. Shaft Creek is an advanced-stage project where three main porphyry Cu-Au-Mo zones have been identified. Teck Resources Limited (2019) reported a Measured plus Indicated resource of 1.29 Bt grading 0.26% Cu, 0.017% Mo, 0.16 g/t Au and 1.24 g/t Ag, and an Inferred resource of 316.7 Mt grading 0.19% Cu, 0.018% Mo, 0.14 g/t Au and 1.12 g/t Ag.

7.2.11. Tatogga (Saddle North; GT Gold Corp.)

The Saddle North discovery at Tatogga was identified late in 2018, where follow-up drilling of an IP chargeability anomaly resulted in the discovery of porphyry Au-Cu mineralization from near surface to depths of greater than 1300 m. Initial drilling highlights included 0.62 g/t Au, 0.36% Cu, and 1.17 g/t Ag across 1150 m. Following these initial results, Newmont Corporation placed \$17.6 million into GT Gold with the intention of accelerating exploration and development. Another \$8.3 million was invested by Newmont Corporation and intended to finance a preliminary economic assessment. In 2019, GT Gold continued to expand mineralization to depth and along trend. Recent drilling has also identified high-grade precious metal veins peripheral to the main body of porphyry mineralization, which included highlights of 4.11 m of 25.42 g/t Au, and 15.70 m of 6.21 g/t Au. A detailed geological model and resource estimate and economic evaluation of Saddle North is expected to be released by the end of the first quarter in 2020.

7.2.12. Thorn (Brixton Metals Corporation)

In 2019, the **Thorn** project increased its mineral claim tenure to 1858 km². Mapping and soil-rock geochemistry at the Chivas zone has expanded the porphyry target 3 km along strike and it remains open. Brixton completed a 9.1 line-km IP-magnetotelluric survey across the Camp Creek copper corridor, which also contains the Oban diatreme breccia pipe and Glenfiddich zone. Exploration in 2019 included 8042 m of drilling; highlights from Oban were 0.57 g/t Au, 0.24% Cu, 43 g/t Ag, 0.55% Zn, and 0.28% Pb across 554 m.

7.2.13. Treaty Creek (Tudor Gold Corp. 60%; Teuton Resources Corp. 20%; American Creek Resources Ltd. 20%)

The 17,913 ha **Treaty Creek** project borders the KSM property to the southwest and the Brucejack property to the southeast. Drilling in 2019 focussed on the Goldstorm zone, which resembles porphyry Au-Cu mineralization, but with a base-metal association. Drilling, which totalled 9780 m in 14 holes, returned highlights of 2.006 g/t Au across 87 m, within 336 m averaging 1.004 g/t Au. Silver and copper mineralization is associated with deeper gold horizons and remain open in all directions.

7.3. Selected polymetallic base and precious metal projects

The Northwest Region is host to many polymetallic base and precious metal projects (Fig. 1; Table 5). Base metals are explored for throughout the Northwest Region, primarily as polymetallic vein and VMS deposits and to lesser extent SEDEX and manto-style replacement deposits.

7.3.1. Brucejack Regional (Pretium Resources Inc.)

In 2019, more than 15,000 m of core were drilled at the regional Brucejack prospects. Drilling early in the year was focussed on epithermal (Tuck and Lilliane zones), and VMS targets (A6 and Canoe zones). Intrusion-related gold (Koopa zone) targets were drilled later in the year. Regional grassroots sampling, regional mapping, prospecting, geophysics, and hyperspectral mapping were also conducted on the Bowser mineral claims. At the A6 zone, mineralization is in Iskut Formation mudstones in a section containing massive and pillowed basalts and a 150 m-thick interval of sericite-chlorite altered rhyolite. This bomodal volcanism is similar to that at the Eskay Creek deposit. Drill highlights from the mudstone are 1.5 m grading 2890 g/t Ag and 1.81% Cu.

7.3.2. Del Norte (Teuton Resources Corp.)

In 2019, Teuton Resources drilled four holes at its **Del Norte** property, 30 km east of Stewart. A ZTEM survey carried out in 2018 detected an anomaly, which was the main target for drilling. The anomaly was named the A2 zone and is coincident with an EM anomaly defined by a VTEM survey completed in 2005. On the ground, mapping has highlighted a bimodal volcanic sequence with the presence of anhydrite in a pyrite-bedded mudstone. Anomalous zinc and silver values

are contained in the same mudstone. The 2019 drilling was inconclusive, and the company plans geophysical surveys to recognize possible VMS-mineralization next year.

7.3.3. Dolly Varden (Dolly Varden Silver Corporation)

The **Dolly Varden** (Dolly Varden Silver Corporation) project is an advanced-stage property that consists of the Torbrit, Dolly Varden, Wolf, Northern Star, and Bonus zones, where four mineralized facies of exhalative stratiform mineralization are recognized. In 2019, the company conducted preliminary metallurgical testing, 11,000 m of drilling, geochemical sampling, prospecting and geological mapping. Drilling at the Chance target intersected highlights of 15.20 m grading 488.3 g/t Ag, 0.55% Pb, and 0.05% Zn. Dolly Varden released an updated mineral resource in 2019 with total Indicated resources of 3.42 Mt grading 299.8 g/t Ag and an additional Inferred resource of 1.29 Mt grading 277.0 g/t Ag.

7.3.4. Dunwell (American Creek Resources Ltd.)

American Creek's **Dunwell** project is between Ascot Resource's Premier and Red Mountain projects near Stewart. The historic Dunwell mine produced 45,657 t grading 6.63 g/t Au, 223.91 g/t Ag, 1.83% Pb, 2.43% Zn. In 2018, American Creek collected 30 samples from multiple locations on the Dunwell property, where high-grade assays persisted along strike for 3 km. As part of the 2019 exploration program, 2000 m was drilled to test multiple targets.

7.3.5. Eskay Creek (Skeena Resources Limited)

The past-producing Eskay Creek mine was one of the highest grade gold mines in the world and fifth-largest silver producer by volume, with 3.3 Moz of Au and 160 Moz of Ag (average grades of 45 g/t Au and 2224 g/t Ag). Considered a VMS-type deposit, mineralization is in a section of submarine siliciclastic and bimodal felsic-mafic volcanic rocks deposited in north-trending rift. High-grade precious metal mineralization (associated with orpiment-realgar-stibnite) is not hosted homogeneously throughout the mudstone sequences and is spatially associated with vents fed from the lower-grade, synmineral rhyolite-hosted feeders. Drilling in 2019 focussed on upgrading areas of Inferred resources into the Indicated category. Highlights include 312.81 g/t Au and 95 g/t Ag across 2.21 m (Fig. 2), and separately 6.75 g/t Au and 285 g/t Ag across 27.50 m. A pit-constrained Indicated mineral resource is reported at 12.65 Mt at 4.3 g/t Au, 110 g/t Ag with an Inferred resource of 14.42 Mt at 2.3 g/t Au, 47 g/t Ag. An underground Indicated resource of 819,000 t at 6.4 g/t Au and 139g/t Ag and an Inferred resource of 295,000 t at 7.1 g/t Au and 82 g/t Ag were reported.

7.3.6. Golddigger (Goliath Resources Limited)

Field reconnaissance work at the **Golddigger** property in 2019, designed to follow up targets generated via lidar and geochemical sampling data, led to the discovery of a new zone, the Sure Bet zone. Contained in a broad alteration halo,



Fig. 2. Eskay Creek NQ diamond drill core from hole SK-19-063 at 111.8 m with 2.21 m grading 312.81 g/t Au and 95 g/t Ag. Visible electrum (top left; circled in red) is found in an interval of mineralized mudstone containing galena and sphalerite with disseminated pyrite in 21A zone.

the zone is cut by multiple NW-SE trending structures that host polymetallic massive sulphide mineralization (galenasphalerite-pyrite). A single channel sample resulted in 8.4 m of 7.37 g/t Au, including 3.4 m of 17.68 g/t Au. More than thirty chip samples were collected; most returned assays >1.4 g/t Au.

7.3.7. Midas (Juggernaught Exploration Ltd.)

In 2018, Juggernaught completed an exploration program on **Midas** that was designed to better understand the controls on mineralization. The 2019 drill program included nine holes totalling 2548 m and was focussed on expanding possible VMS mineralization at depth and along strike, which were identified initially by subsurface IP chargeability and resistivity anomalies. Polymetallic veins with silver-copper-gold and generally associated with silica-sericite altered volcanic rocks were encountered.

7.3.8. Pitman (Casa Minerals Inc.)

Casa Mineral's **Pitman** project is approximately 20 km north of Terrace and lies adjacent to the Skeena river. Hazelton Group intermediate flows and fragmental volcanic rocks are cut by Coast Plutonic complex quartz diorite-monzonite rocks and in turn cut by granite porphyry and andesite dikes. The two main zones at Pitman are the Golden Dragon and Dragon tale, and previous sampling returned 574 g/t Au in quartz veins across 1 m at the Golden Dragon zone. Both prospects were drilled in 2019, totalling 2037 m.

7.3.9. Rock and Roll (Etruscus Resources Corp.)

Access to the **Rock and Roll** property is via helicopter from the Forest Kerr hydroelectric facility, where the claim block lies in the Iskut River valley. The Black Dog VMS deposit was a discovery made 30 years ago and provides the Rock and Roll property with an Inferred mineral resource estimate of 2.02 Mt grading 0.71 g/t Au, 87.1 g/t Ag, 0.23% Cu, 0.23% Pb, and 0.98% Zn. Two phases of sulphide mineralization are recognized at the Black Dog deposit and mineralization is in Stikine assemblage and Stuhini Group rocks, which consist of interbedded andesite volcanic rocks and siltstones. Because of thick overburden, Etruscus Resources conducted a biogeochemical orientation survey, which tested pathfinder elements (Au, Ag, Ba, Cu, Fe, Hg, Pb, Se, Zn) in 58 bark samples over known and unknown mineralized areas. In addition to surface sampling, approximately 2500 m of diamond drilling was conducted.

7.3.10. Silver Queen (Equity Metals Corporation)

In September, New Nadina Explorations changed its name to Equity Metals Corporation, where its flagship property is the **Silver Queen** project. The property is south of Houston, close to past producing mines (Huckleberry and Equity Silver). Mineralization is similar to the Equity Silver mine, where it is characterized as a transitional porphyry-epithermal type deposit. Polymetallic mineralization is in 1-2 m-wide quartz-calcitebarite veins as disseminated to locally massive sphalerite, galena, chalcopyrite, and sulfosalts. In 2019, historic data were compiled and interpreted and, in August, a mineral resource estimate was released with Indicated resources of 0.815 Mt at 6.35% Zn, 3.24 g/t Au, 201.4 g/t Ag, 0.26% Cu, and 0.96% Pb with additional Inferred resources of 0.801 Mt at 5.21% Zn, 2.49 g/t Au, 184.3 g/t Ag, 0.31% Cu, and 0.88% Pb (resources at NSR cut-off of \$100/t).

7.3.11. Todd Creek (ArcWest Exploration Inc.)

The 34,000 ha Todd Creek property adjoins mineral claims to the north and west of Pretium's Brucejack claim boundary and is 30 km northeast of Stewart. The project contains a 3 by 12 km alteration corridor and mineralized showings immediately adjacent to a regional N-S structure in Hazelton Group rocks. Locally, volcanic rocks are cut by monzodiorite dikes that are cut by east-west sulphide-bearing hydrothermal breccias along a 3-km strike length. In 2018, the VMS East zone was sampled and returned highlight assays of 1.98% Cu, 9.15% Zn, 0.392 g/t Au and 112 g/t Ag. The 2019 exploration program included additional sampling of VMS East zone and a 900 m overall strike length of mineralization was recognized. Four hundred metres to the west of VMS East zone a newly discovered zone of outcropping VMS-style mineralization was discovered and has been traced for 400 m north-south. Grab samples from this new zone (VMS West) returned assays of 2.05 g/t Au and 1.21% Cu.

7.4. Selected mafic- and ultramafic-hosted projects

The Northwest Region contains only a few mafic- and ultramafic-hosted prospects (Fig. 1; Table 5).

7.4.1. Nickel Mountain (Garibaldi Resources Corp.)

The 6300 ha **Nickel Mountain** project contains the E&L zone and is Garibaldi Resources flagship project. A new high-grade zone was discovered in 2017, and 16.75 m of diamond drill core assayed 8.3% Ni, 4.2% Cu, 0.19% Co, 1.96 g/t Pt, 4.5 g/t Pd, 1.1 g/t Au and 11.1 g/t Ag (Fig. 3). Exploration in 2019



Fig. 3. Nickel Mountain NQ diamond drill core from Discovery Hole 14. Massive pyrrhotite with chalcopyrite intergrowths are rimmed by pentlandite. Assays from this 0.5-m section returned 7.78% Ni, 3.14% Cu, 0.48g/t Au, 0.78g/t Pt, 1.35 g/t Pd, 7.1 g/t Ag. Scale in cm.

was designed to infill the five known zones of mineralization and further explore at depth and along strike. Approximately 25,000 m were drilled in 2019 and highlights include 18.2 m grading 7.04% Ni and 3.81% Cu within a broader zone of mineralization of 86.5 m grading 1.88% Ni and 1.32% Cu.

7.4.2. Turnagain (Giga Metals Corporation)

The Turnagain ultramafic-mafic complex (190 Ma; U-Pb titanite; Scheel et al., 2005) includes cumulate sequences with dunite bounding wehrlite, olivine clinopyroxene, and clinopyroxene. The complex is elongate and broadly follows the regional northwesterly trend. Four main zones of mineralization (Horsetrail, Northwest, Hatzl, and Duffy zones) have been recognized at Turnagain and contain and contain sulphide mineralization as pyrrhotite, pentlandite, chalcopyrite, and trace bornite. In September of 2019, an updated Measured plus Indicated resource was reported of 1.073 Bt grading 0.220% Ni and 0.013% Co, and an Inferred resource of 1.142 Bt grading 0.217% Ni and 0.013% Co. These Measured plus Indicated resources equate to 5.2 Blbs of Ni and 312 Mlbs of Co, a 28.3% increase in Ni from the previous estimate. The updated estimate was based on an additional 36 infill drill holes totalling 8940 m drilled previously in 2018. A Preliminary Economic Assessment (PEA) is expected as early as first quarter of 2020.

8. Geological research

Febbo et al. (2019) documented the magmatic and structural evolution of the Mitchell deposit (**KSM**), emphasizing the role of basement structures in controlling Triassic-Early Jurassic porphyry systems. Bouzari et al. (2019) found the potential for deeper porphyry Cu-Au deposits beneath areas previously known for shallow epithermal deposits in the Toodoggone region. Angen et al. (2019a) published a compilation of new and previous mapping with interpretations guided by new aeromagnetic data (Angen et al., 2019b) in the western Skeena

arch. Hunter and van Straaten (2020) began a multi-year program mapping Stuhini Group and Hazelton Group rocks in the Kitsault Lake area near the **Dolly Varden** property and provided facies analysis and the preliminary results of new U-Pb zircon geochronology. Working nearby at Kinskuch Lake, Miller et al. (2020) identified a major tectonostratigraphic break at the transition between the Stuhini Group and the Hazelton Group and provided a new U-Pb zircon age from the Big Bulk porphyry prospect.

9. Summary

The Northwest Region has several producing mines and many proposed and advanced-stage projects. In 2019, the region saw numerous active early-advanced stage projects that focussed mainly on precious, base metal, and porphyry deposits. Exploration activity increased for the third consecutive year. Many companies reported positive exploration results, and many new targets were generated. Large international companies are beginning to move into the Northwest Region.

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Exploration and mining in the North Central and Northeast regions, British Columbia

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1. Introduction

From northeast to southwest, a transect from the Northeast Region though the North Central Region provides a cross section from undeformed rocks deposited above Precambrian basement to allocthonous terranes accreted to ancestral North America (Fig. 1). Platformal sedimentary rocks in the Northeast Region transition to deep-water basin strata as the eastern limit of Cordilleran deformation is approached, close to the border of the North Central Region. The North Central Region shows a history of ocean opening and closing, island arc volcanism, and terrane accretion onto the western margin of ancestral North America. Terrane emplacement was followed by continued orogeny, magmatism and sedimentation. Both regions were extensively glaciated.

The Northeast Region is prospective for coal and industrial minerals and, at present, has three producing coal mines, Conuma Coal Resources Limited's **Wolverine**, **Brule**, and **Willow Creek** operations and several major coal projects. In the far north of the region, Fireside Minerals Ltd. produces barite from its **Fireside** mine to supply the oil and gas drilling industry.

The North Central Region is prospective for Cu, Au, Ag, Zn, Pb, specialty metals, and rare earth elements, mostly in porphyry, vein and stockwork, SEDEX, and carbonatite settings. The **Mt. Milligan** Cu-Au operation (Centerra Gold Inc.) is the only producing mine in the region. Graymont Western Canada Inc. continues the permitting process for its **Giscome** project. The **Blackwater** epithermal Au-Ag project (New Gold Inc.) received federal and provincial Environmental Assessment Certificates in 2019. Both regions also saw numerous exploration projects (Fig. 1). Significant results included those reported for Benchmark Metals Inc.'s **Lawyers** project, Sun Metals Corp.'s **Stardust** project and ZincX Resources Corp.'s **Akie** project.

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 Petroleum Resources, the Association for Mineral Exploration in British Columbia, and EY LLP. For the North Central Region, exploration expenditures were estimated at \$35.5 million and exploration drilling was estimated at approximately 92,600 m. For the Northeast Region exploration expenditures were estimated at \$8.8 million and exploration drilling was estimated at approximately 11,050 m (Clarke et al., 2020; EY LLP, 2020).

2. Geological overview

The Canadian Cordillera records a protracted history of supercontinent rifting followed by collisions between the westward-driven North American continental plate and a succession of island arc volcanosedimentary and intrusive assemblages (terranes), developed outboard of ancestral North America and accreted to each other and to the continental margin (e.g., Nelson et al., 2013). Terrane evolution continues today as the Juan de Fuca plate slides beneath Vancouver Island. In the Northeast and Central regions, the most easterly rocks are platformal sedimentary units that thicken westward and transition to deep-water basin strata. These rocks are deformed mainly by eastward-vergent thrust faults and folds along northwest-southeast trends. The Rocky Mountain trench marks the site of about 800 km of post-accretion dextral strike slip along the Tintina fault system.

Deformed deep-water basin sedimentary rocks immediately west of the Rocky Mountain Trench are referred to as the Cassiar terrane (Fig. 1). Outboard of the Cassiar terrane is a group of volcanic assemblages referred to (roughly from east to west) as the Slide Mountain terrane, the Quesnel and Stikine terranes (Quesnellia and Stikinia), and the Cache Creek terrane. The Cache Creek terrane is separated from Quesnellia by another major crustal break, the Pinchi fault, along which areas of ultramafic rocks are locally exposed. These terranes are intruded by intermediate to felsic plutonic and volcanic rocks and are in turn overlain by later sedimentary and volcanic rocks.

Mineral deposit types and distributions are intimately related to the geologic evolution of the terranes (e.g., Nelson et al., 2013). Thus, platformal rocks deposited above ancestral North America host coal and potash deposits, and post-accretionary sedimentary rocks overlying the Stikine terrane host coal deposits. Deep-water basin strata host SEDEX and Mississippi



Clarke



Fig. 1. Mines and selected projects, North Central and Northeast regions, 2019. Terranes after Nelson et al. (2013).

Provincial Overview of Exploration and Mining in British Columbia, 2019. British Columbia Geological Survey, Information Circular 2020-01

Valley-type lead-zinc deposits and are intruded by carbonatite bodies hosting niobium and rare earth elements (REE). The island arc assemblages of Quesnellia and Stikinia host the known large polymetallic porphyry and orogenic precious metal deposits in the region.

3. Mines and quarries

During 2019, one metal mine operated in the North Central Region, three coal mines operated in the Northeast Region and one industrial mineral mine operated in the Northeast Region (Fig. 1; Tables 1-3).

3.1. Metal mines

The only producing metal mine in 2019 is in the North Central Region; **Mt. Milligan** (Cu-Au) wholly-owned by Centerrra Gold Inc. (Fig. 1; Table 1).

3.1.1. Mt. Milligan (Centerra Gold Inc.)

The Mt. Milligan mine, in the Quesnel terrane (Fig. 1), is hosted by mafic to intermediate volcanic and pyroclastic rocks of the Takla Group (Triassic to Lower Jurassic) that are intruded by Lower Jurassic monzonite porphyry stocks. The ore body ($2500 \times 1500 \text{ m}$) is a silica-saturated alkalic porphyry deposit in which Cu-Au (with accessory Ag) mineralization is in sulphides. The deposit consists of two principal zones. At the Main zone, mineralization is mainly in volcanic rocks; at the Southern Star zone, mineralization is in a monzonite stock and volcanic rocks.

The mine was commissioned in 2013. Ore is initially processed through primary and secondary crushers, before milling and flotation in a 62,500 tpd design capacity concentrator. The concentrate, averaging about 23% Cu, is moved by truck to Mackenzie, where it is transferred to rail cars and shipped to North Vancouver for transport to markets. Year-end (2018) combined Measured and Indicated mineral resources were reported as 342.23 Mt at 0.136% Cu and 0.2 g/t Au. Year-end (2018) combined Proven and Probable Mineral reserves were reported as 447.56 Mt at 0.186% Cu and 0.3 g/t Au. The mine has a projected +20-year mine life.

3.2. Coal mines

Conuma Coal Resources Ltd. produces from the Willow Creek, Wolverine and Brule mines (Fig. 2; Table 2).

3.2.1. Willow Creek Mine (Conuma Coal Resources Ltd.)

Forecast production for the Willow Creek mine was 820,000 t of hard coking coal (HCC) and pulverized coal injection (PCI) product.

3.2.2. Brule Mine (Conuma Coal Resources Ltd.)

Forecast production for the Brule mine was 2.62 Mt of clean PCI coal. The coal is contained in folded and thrust-faulted rocks. The coal product is moved by rail to the wash plant at the Willow Creek mine site before being shipped by rail for export at Ridley Terminal in Prince Rupert.

3.2.3. Wolverine Mine (Conuma Coal Resources Ltd.)

Forecast production for the Wolverine mine was 1.19 Mt of HCC. Coal from the mine is trucked to Conuma's rail facility at the Brule mine, where it is loaded for rail transport to the company's wash plant at Willow Creek. Coal is mined from the Perry Creek pit which is nearing the end of its resources. Conuma has applied to the Environmental Assessment Office for an amendment that would allow them to mine coal from the Hermann pit and use the existing Wolverine processing plant and loadout facilities.

3.3. Industrial mineral mines and quarries

In 2019, only the Fireside mine, which produces barite, was in operation in the Northeast Region. In the North Central Region, Green Mountain Jade Inc.'s Ogden Mountain mine was on care and maintenance (Fig. 1; Table 3).

3.3.1. Fireside (Fireside Minerals Ltd.)

Fireside Minerals Ltd. quarries massive white barite from veins cutting Paleozoic sedimentary rocks of the Kechika Group near the Yukon border. The barite veins are steeply dipping, trend north to northeast, and have a combined true thickness of 6.5 m. Barite concentrations in the veins range from 96.0 to 99.4% BaSO₄. The product is bagged and trucked to Fort St. John and to Alberta, where it is used to produce high-density drilling mud.

4. Placer operations

Placer exploration is a widespread activity in parts of British Columbia, and permits are required only when surface disturbance is proposed. In the North Central Region, operations are distributed primarily in the Manson Creek, Fort St. James to Mackenzie, and Hixon areas. Larger scale operations are generally sited on abandoned stream channels and benches, and use backhoes and hydraulic excavators to extract gravel, which is then processed through a wash plant, either on-site or at a remote location. Because of the number of operations and difficulty in obtaining information, these operations are not tracked.

5. Mine or quarry development

There were no mines under development in the North Central and Northeast regions in 2019.

6. Selected proposed mines or quarries

Projects at the proposed mine stage (Fig. 1; Table 4) in the North Central Region include three proposed metal mines, New Gold Inc.'s **Blackwater** project, Taseko Mines Limited's **Aley** project and Centerra Gold Inc.'s **Kemess Underground** project. Also, in the North Central Region, Greymont Western Canada Inc.'s **Giscome** project is a proposed industrial mine. Proposed mine coal projects in the Northeast Region (Fig. 1; Table 4) include Conuma Coal Resources Limited's **Wolverine-Herman** amendment project, HD Mining International Ltd.'s **Murray River** project and Glencore plc's **Sukunka** project.

Mine	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2019 Production (based on Q1- Q3)	Reserves	Resource	Comments
Mt. Milligan	Centerra Gold Inc.	Cu, Au, Ag; Alkalic porphyry Cu- Au; 093N 194, 191	74 Mlbs Cu 190 Koz Au	P+Pr: 447.56 Mt at 0.186% Cu and 0.3 g/t Au	M+I: 342.23 Mt at 0.136% Cu and 0.2 g/t Au (additional to reserves)	Concentrator design capacity 62,500 tpd. Estimated mine life +20 years. More than 350 employees.

Table 1. Metal mines, North Central Region.

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

Table 2. Coal mines, Northeast Region.

Mine	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2019 Production (based on Q1- Q3)	Reserves	Resource	Comments
Willow Creek	Conuma Coal Resources Limited	HCC, PCI; Bituminous coal; 093O 008	820,000 t	P+Pr: 11.04 Mt	na	About 220 employees, mine and plant.
Brule	Conuma Coal Resources Limited	PCI; Bituminous coal; 093P 007	2.62 Mt clean	P+Pr: 12.26 Mt	na	About 230 employees.
Wolverine	Conuma Coal Resources Limited	HCC; Bituminous coal; 093P 025	1.19 Mt	P+Pr: 26.99 Mt	na	About 300 employees, mine and plant.

HCC = hard coking coal; PCI = pulverized coal injection; TC = thermal coal; ULV = ultra low volatile P = Proven; Pr = Probable; M = Measured; I = Indicated; Inf = Inferred

Table 3. Selected industrial mineral mines and quarries, North Central and Northeast regions.

Mine	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2019 Production (based on Q1-Q3)	Reserves	Resource	Comments
Fireside (Northeast Region)	Fireside Minerals Ltd.	Barite; Vein barite; 094M 003, 19	na	na	na	Product is bagged and trucked to Fort St. John and to Alberta, where it is used to produce high- density drilling mud.
Ogden Mountain (North Central Region)	Green Mountain Jade Inc.	Nephrite jade; Jade; 093N 156, 157, 165	na	na	na	Placed on care and maintenance in late 2017.

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

Fertoz International Inc.'s **Wapiti East** project is a proposed industrial mineral mine in the Northeast Region (Fig. 1; Table 4).

6.1. Proposed metal mines

There are three proposed metal mines, all in the North Central

Region: Taseko Mines Ltd.'s **Aley** Niobium project; New Gold Inc.'s **Blackwater** Au-Ag project; and Centerra Gold Inc.'s Cu-Au-Ag **Kemess Underground** project.

6.1.1. Aley (Taseko Mines Ltd.)

Taseko Mines Ltd.'s wholly-owned Aley niobium-bearing



Fig. 2. Coal mines and exploration projects, northeastern British Columbia, 2019. From British Columbia Geological Survey (2020).

Provincial Overview of Exploration and Mining in British Columbia, 2019. British Columbia Geological Survey, Information Circular 2020-01

Project	Operator (partner)	Commodity; deposit type; MINFILE	Reserves	Resource	Comments
Aley (North Central Region)	Taseko Mines Ltd.	Nb; Carbonatite- hosted; 94B 027	P+Pr: 83.8 Mt at 0.50% Nb ₂ O ₅ (at 0.30% Nb ₂ O ₅ cut-off)	M+I: 285.8 Mt at 0.37% Nb ₂ O ₅ (at 0.20% Nb ₂ O ₅ cut-off)	Proposed open-pit mine with 10,000 tpd ore processing rate and average annual production of 9000 t Nb over a 24-year mine life. In 2019, environmental monitoring, pilot plant to provide product samples.
Blackwater (North Central Region)	New Gold Inc.	Au, Ag; Epithermal Au-Ag-Cu, intermediate sulphidation; 093F 037	P+Pr: 334.4 Mt at 0.74 g/t Au, 5.5 g/t Ag, containing 8.17 Moz Au, 60.8 Moz Ag (combined direct processing and low grade)	M+I: 61.32 Mt at 0.71 g/t Au, 4.4 g/t Ag, containing 1.40 Moz Au, 8.73 Moz Ag (combined direct processing and low grade, exclusive of reserves)	Received Federal and Provincial Environmental Assessment certificates. Drilling (3 DDH, 342 m, 12 sonic/air rotary, 750 m). Proposed open-pit mine with 60,000 tpd ore processing rate and life-of-mine average annual production of 413 Koz Au and 1.74 Moz Ag over a 17-year mine life.
Giscome (North Central Region)	Graymont Western Canada Inc.	CaCO ₃ ; Limestone; 093J 041, 25	na	I: >100 Mt of limestone (>95% calcium carbonate, <5% magnesium carbonate) in situ	Environmental Assessment under review. Proposed 600,000 tpy limestone quarry to feed a vertical lime kiln producing 198,000 t of lime annually over a 50+ year mine life.
Kemess Underground (KUG) (North Central Region)	Centerra Gold Inc.	Cu, Au, Ag; Porphyry Cu±Mo±Au; 094E 021	Pr: 107.38 Mt at 0.27% Cu, 0.54 g/t Au, 1.99 g/t Ag; containing 629.6 Mlbs Cu, 1.87 Moz Au, 6.88 Moz Ag	I: 246.4 Mt at 0.22% Cu, 0.42 g/t Au, 1.75 g/t Ag; containing 1195 Mlbs Cu, 3.33 Moz Au, 13.87 Moz Ag (inclusive of reserves)	Permitted, proposed underground panel cave mine with 24,600 tpd ore processing rate and life- of-mine average annual production of 106,000 oz Au and 47 Mlbs Cu over a 12- year mine life.
Murray River (Northeast Region)	HD Mining International Ltd.	Coal; Bituminous; 093I 035	P: 261.1Mt mineable coal	M+I: 314.2 Mt coal in situ Inf: 373.9 Mt coal in situ	Provincial and Federal EA certificates in place. Mine plan and reclamation program approved April 2018. Would produce 6 Mtpy from two longwall faces over 25-year mine life with 764 direct jobs.
Sukunka (Northeast Region)	Glencore Canada Corporation	Coal; Bituminous; 093P 014	na	145.0 Mt coal in situ	20+ year mine life at 1.5- 2.5 Mt saleable coal per year, 250 permanent jobs once operational. Permitting in progress.
Wapiti East (Northeast Region)	Fertoz International Inc.	P ₂ O ₅ ; Sedimentary phosphate deposits; 093I 008, 22, 15	na	I+Inf: 1.54 Mt 21.6% P ₂ O ₅	Permitting in progress. Proposed seasonal shallow open pit mine with annual production of less than 75,000 t over a +20year mine life.

 Table 4. Selected proposed mines and quarries, North Central and Northeast regions.

Table 4.	Continued.
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Wolverine-	Conuma Coal	Coal;	P: 10.7 Mt	M: 15.0 Mt	Drilling (6 DD, 1937 m,
Herman	Resources	Bituminous;	Pr: 3.6 Mt	I: 15.6 Mt	6 RC, 721 m, Sonic,
Amendment	Limited	093I 031		Inf: 9.6 Mt	26,780 m).
(Northeast					
Region)					

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

carbonatite project is near the western extremity of platformal strata. The carbonatite intrusion is oval in map view, measuring about 2.0 x 2.8 km. Within that body, reserves stand at 84 Mt grading 0.5% Nb₂O₅. An open-pit mine is proposed, processing 10,000 tpd and producing ferroniobium. The projected mine life is 24 years with an output of about 9 Mkg of niobium annually, making it among the largest niobium deposits in the world. Environmental assessment is underway. In 2019, Taseko continued environmental monitoring and began product development and marketing initiatives. A pilot plant program was initiated, to build on bench-scale niobium flotation and converter processes and to provide product samples for marketing.

6.1.2. Blackwater (New Gold Inc.)

The **Blackwater** project is accessible by existing roads, but development would require construction of a 140-km power transmission line from a substation south of the community of Endako.

Combined direct processing and low grade Proven and Probable reserves stand at 344.4 Mt grading 0.74 g/t Au and 5.5 g/t Ag. As proposed, Blackwater would be a 60,000 tpd operation with a 17-year mine life. Once completed, the operation would consist of an open pit, an ore processing facility, a waste rock dump, a tailings pond, water management facilities, offices, employee accommodations, warehouses, and a truck shop.

The Blackwater deposit is hosted by a sequence of intermediate to felsic volcanic rocks in the Kasalka Group (Upper Cretaceous; the Stikine terrane). In this intermediate sulphidation, epithermal system, the host rocks are pervasively fractured and sericitzed, and sulphides include pyrite, sphalerite, marcasite and pyrrhotite. These occur as disseminations and pore fillings, which are strongly controlled by a set of northeastand northwest-trending faults.

In 2019, New Gold received both provincial and federal Environmental Assessment Certificates but has not yet decided when to initiate the final mine permitting process as they reevaluate project sizing and processing options. New Gold continued collecting baseline data and drilled three diamond drill holes totalling 342 m and 12 sonic/air rotary drill holes totalling 750 m.

6.1.3. Kemess Underground (Centerra Gold Inc.)

The **Kemess Underground** (KUG) project is a calc-alkaline porphyry Cu-Au-Ag deposit in the North Central Region. The

deposit comprises a low-grade ore zone at a depth of 150 m on its western flank; and a higher-grade zone, at 300 m depth, 550 m to the east. KUG is hosted by a porphyritic monzodiorite/ diorite pluton and related dikes that intrude potassically altered Takla Group volcanic rocks and Black Lake plutonic rocks. Secondary biotite alteration in the volcanic rocks and the eastern plutonic rocks characterize the higher-grade Cu-Au mineralization.

The deposit is estimated to contain an Indicated resource of 246.4 Mt grading 0.22% Cu, 0.42 g/t Au and 1.75 g/t Ag. Within this resource are Probable reserves of 107.4 Mt grading 0.27% Cu, 0.54 g/t Au and 1.99 g/t Ag.

The former Kemess South mine closed in 2011. However, infrastructure remains in place, and both the camp and ore processing plant will be used to service KUG, which is about 6.5 km north of the former processing plant. KUG is considered a stand-alone operation, to be mined by panel caving with crushed ore conveyed underground to the processing plant. Processing rate would be 24,600 tpd with a life of mine average production of 106,000 oz au and 47 Mlbs Cu over a 12-year mine life.

Kemess East (KE), about 1 km east of KUG, is an underground operation that could be integrated into the KUG project and use facilities developed for KUG. KE has an Indicated resource of 113.1 Mt grading 0.38% Cu, 0.46 g/t Au and 1.95 g/t Ag and an Inferred resource of 63.8 Mt grading 0.34% Cu, 0.31 g/t Au and 1.90 g/t Ag.

Waste rock and tailings from KUG will be placed in the former open pit modified by a 25 m high dam, along with a small amount of KE tailings. Non-acid generating tailings from KE would be placed in dry-stack storage. The KUG project has approval for development but Centerra is currently concentrating resources elsewhere. In 2019, drilling in four diamond drill holes totalled 5347 m.

6.2. Selected proposed coal mines

HD Mining International's **Murray River** project received its Mines Act approval in 2018 and awaits a final investment decision. The British Columbia Environmental Assessment Office lists Glencore plc's **Sukunka** project as 'in progress'. Conuma Coal Resources Ltd.'s **Wolverine-Herman Amendment** project is a proposed satellite operation for Conuma's Wolverine mine.

6.2.1. Murray River (HD Mining International Ltd.)

Murray River is a proposed underground mine that would

extract metallurgical coal from the Gates Formation. In 2015, HD Mining International Ltd. completed bulk sampling for testing coal quality, processing, and marketability. In April 2018, the company received its Mines Act permit. An adit, driven to collect the bulk sample in 2015 but also to be used for the mining conveyor, descends 1.3 km down a decline. Two vertical shafts are to be completed, one for moving staff and equipment, and the other for ventilation. HD Mining plans to construct its own wash plant and use existing rail facilities. The project is expected to provide about 764 jobs in direct employment during a 25-year mine life. Chinese miners experienced in longwall methods would start production but would be replaced within 10 years once Canadian miners are trained. Murray River awaits a final investment decision by HD Mining's parent company, China Huiyong Holdings.

6.2.2. Sukunka (Glencore plc and JX Nippon Oil and Energy Corporation)

The **Sukunka** project has been planned as both an open-pit and underground operation, extracting coal from the Gething Formation. The project is listed on The British Columbia Environmental Assessment Office website as 'in progress'.

6.2.3. Wolverine-Herman Amendment (Conuma Coal Resources Ltd.)

In July 2019, Conuma applied to the Environmental Assessment Office to open-pit mine coal at the **Wolverine-Herman Amendment** project, as a satellite to the Wolverine mine. If approved the Hermann pit would produce 1.5 to 3 Mt of coal per year and add up to 7 years to the life of the wash plant at the Wolverine mine. At the site, Conuma completed six diamond drill holes totalling 1937 m, six reverse circulation drill holes totalling 721 m and 26 sonic drill holes totalling 780 m.

6.3. Selected proposed industrial mineral mines or quarries

Proposed industrial mineral mines or quarries include Graymont Western Canada Inc.'s **Giscome** project in the North Central Region and Fertoz Ltd.'s **Wapiti East** project in the Northeast Region.

6.3.1. Giscome (Graymont Western Canada Inc.)

At the **Giscome** project, Graymont Western Canada proposes to exploit a high-purity limestone deposit in basaltic rocks of the Antler Formation (Triassic; Slide Mountain Group). Crushed stone would be transported about 5 km by truck to lime kilns at a former stone quarry, owned and operated by CN Rail, in the community of Giscome. An existing CN Rail line would be used for transporting the product.

The environmental assessment review for the project is in place, and the Mines Act Permit process is underway. The company anticipates starting construction in about 2025, with up to 600 Kt of limestone quarried annually. The product would service mining and pulp and paper operations in northern British Columbia. Once in operation, the project would provide about 10 seasonal jobs at the quarry and a further 15 or more at the lime plant and would remain in production for about 50 years.

6.3.2. Wapiti East (Fertoz Ltd.)

Fertoz Ltd.'s **Wapiti East** project is a proposed phosphate mine. Combined Indicated and Inferred resources are 1.54 Mt grading $21.6\% P_2O_5$ (at a 7% cut-off). Permitting is ongoing but the process has faced delays due to caribou issues. In 2019, water monitoring was undertaken as part of the permitting process.

7. Selected exploration activities and highlights

Exploration activity in 2019 for both the North Central and Northeast regions (Fig. 1; Tables 5, 6) was down slightly compared to the previous year but overall expenditures for both regions were up slightly. Significant programs included drilling at Lawyers (Benchmark Metals Inc.), Fran (MGX Minerals Inc.), Mt. Milligan, Brownfield and Greenfield programs (Centerra Gold Inc.) and Stardust (Sun Metals Corp.).

7.1. Selected precious metal projects

Precious metals projects were underway in 2019, all in the North Central Region (Fig. 1; Table 5). Projects included **AK** (Exodus Mineral Exploration Ltd.) **Lawyers** (Benchmark Metals Inc.), and **Snowbird** (Gitennes Exploration Corp.).

7.1.1. AK (Exodus Mineral Exploration Ltd.)

The **AK** gold prospect was discovered by prospectors Max Keogh and Andreas Angele in early 2018. It consists of a set of quartz veins with associated shear zones, intruding Takla Group volcanic rocks. Analysis of one specimen from the 'discovery vein' returned 8 g/t Au. In 2019, work include additional trenching and sampling.

7.1.2. Gibson (CANEX Metals Inc.)

In early 2019, CANEX reported new and updated results for a 10-hole, 1001 m drill program carried out in late 2018. All holes were within about 1 km of the Hogem batholith, and targeted silver mineralization with associated galena. A new zone of quartz-sulphide veins was discovered adjacent to the main Gibson trend. Highlight results included 1.0 m of 11.9 g/t Au and 301 g/t Ag and 0.5 m of 2.7 g/t Au and 872 g/t Ag.

7.1.3. Lawyers (Benchmark Metals Inc.)

The Lawyers project is a regional-scale prospect that follows northwest-trending linear magnetic and radiometric anomalies with multiple gold-silver showings for more than 20 km. Showings include the Cliff Creek, Dukes Ridge, Phoenix, Marmot and AGB (Fig. 3) zones. Except for Marmot, all zones are considered part of the same system.

In 2019, Benchmark drilled 47 diamond drill holes totalling 11,000 m. Highlight assays included 4.4 m grading 11.73 g/t Au and 476 g/t Ag at the Cliff Creek zone, 25.0 m grading 2.79 g/t Au and 177 g/t Ag and 2.95 m grading 30.2 g/t Au and
Project	Operator (partner)	Commodity; Deposit type; MINFILE	Resource (NI 43-101 compliant unless indicated otherwise)	Comments
AK	Exodus Mineral Exploration Ltd.	Au-quartz veins	na	Trenching and sampling.
Akie	ZincX Resources Corp.	Zn, Pb, Ag; Sedimentary exhalative Zn- Pb-Ag; 094F 031	I: 22.7 Mt at 8.32% Zn, 1.81% Pb, 14.1 g/t Ag Inf: 7.5 Mt at 7.04% Zn, 1.24% Pb, 12.0 g/t Ag (at 5% Zn cut-off)	PEA proposed 18-year mine life, mine production rate 4000 tpd, 25.8 Mt total mined, initial capital cost \$302.3 million. In 2019, four DDH holes, 2347 m. Results included 10.94 m (true width) of 10.85% Zn, 2.23% Pb and 17.0 g/t Ag and 14.65 m (true width) of 16.20% Zn, 3.39% Pb and 27 g/t Ag.
Atty	Serengeti Resources Inc.	Cu, Mo, Au; Porphyry Cu±Mo±Au	na	Geophysics, 29.8 line-km IP. Drilling six DDH, 2318 m. Results included 87.7 m of 0.04% Cu, 0.14 g/t Au and 0.4 g/t Ag.
Captain	Orestone Mining Corp.	Cu, Au; Alkalic porphyry Cu-Au; 093J 026, 094C 180	na	Drilling, seven DDH, 1900 m. Results included 91 m of 0.065% Cu and 0.26 g/t Au.
Chuchi	Centerra Gold Inc.	Cu, Au; Alkalic porphyry Cu-Au; 093N 159	I: historic non-NI 43-101 compliant: 50 Mt at 0.21- 4.0% Cu, 0.21-0.44 g/t Au (Digger Resources Inc., 1991)	Geophysics, 731 line-km low altitude aeromagnetic survey. Drilling four DDH, 1755 m.
Croy-Bloom	Serengeti Resources Inc.	Cu, Au; Alkalic porphyry Cu-Au; 094D 015, 25, 094C 039, 156	na	Geophysics, 12 line-km of IP. Mapping and sampling.
Decar	FPX Nickel Corp.	Ni; Ultramafic-hosted; 093K 039, 72, 89	2018 I: 1843 Mt at 0.143 DTR (Davis Tube Recoverable) Ni Inf: 391 Mt at 0.115% DTR Ni, at 0.06% cut-off	Bench-scale metallurgical testing produced clean nickel concentrates grading 63 to 65% Ni with improvements in recovery relative to previous testing. By-product iron ore concentrates graded 60 to 65% cent Fe.
Fran	MGX Minerals Inc.	Cu, Au; Alkalic porphyry Cu-Au; 093K 108, 093N 207	na	Drilling, 11 DDH, 4200 m. Results included 1.3 m of 13.5 g/t Au, 2.23 m of 23.26 g/t Au and 8.85 m of 1.0 g/t Au.
Gibson	Canex Metals Inc.	Au, Ag, Cu; Epithermal Au-Ag-Cu, low sulphidation; 093 185	na	Results reported for 10-hole, 1001 m DD carried out in late 2018. Results included 1.0 m of 11.9 g/t Au and 301 g/t Ag and 0.5 m of 2.7 g/t Au and 872 g/t Ag.
Indata	Prophecy Potash Corp.	Cu, Au; na	na	Prospecting and sampling. Rock grab sample results included 3.64% Cu and 5.95 g/t Au. Project under option from Eastfield Resources Ltd.

 Table 5. Selected exploration projects, North Central Region.

Table 5. Continued.

Indy	InZinc Mining Ltd.	Zn, Pb, Ag; Sedimentary exhalative Pb- Zn-Ag; 093N 240	na	Soil surveys (1194 samples), mapping and prospecting.	
Kemess East	Centerra Gold Inc.	Cu, Mo, Au; Porphyry Cu±Mo±Au; 094E 315	I: 113.12 Mt at 0.38% Cu, 0.46 g/t Au, 1.94 g/t Ag, containing 954 Mlb Cu, 1680 Koz Au, 7066 Koz Ag	Potential to be integrated into the Kemess Underground project.	
Kwanika	Kwanika Copper Corp. (65% Serengeti Resources Inc., 35% Posco International Corporation)	Cu, Au, Ag; Porphyry Cu±Mo±Au; 093N 073	I: Central Zone pit: 11.8 Mt at 0.37% Cu, 0.39 g/t Au, 1.07 g/t Ag. Central zone underground: 41.4 Mt at 0.46% Cu, 0.52 g/t Au, 1.36 g/t Ag	Working on an interim study report.	
Lawyers	Benchmark Metals Inc.	Au, Ag, Cu, Zn; Epithermal Au-Ag-Cu, low sulphidation; 094E 066	Inf: Cliff Creek N zone, 550 Kt at 4.51 g/t Au, 209.15 g/t Ag; Duke's Ridge zone, 58 Kt at 4.30 g/t Au, 139.13 g/t Ag	Drilling, 47 DDH, 11,000 m. Results included 4.4 m grading 11.73 g/t Au and 476 g/t Ag at the Cliff Creek zone, 25.0 m grading 2.79 g/t Au and 177 g/t Ag, and 2.95 m grading 30.2 g/t Au and 1361 g/t Ag at the AGB zone, 2.87 m grading 46.9 g/t Au and 3056 g/t Ag at the Phoenix zone and 3.34 m grading 7.85 g/t Au and 830 g/t Ag at the Duke's Ridge zone.	
Mt. Milligan on-lease (brownfield) and off-lease (greenfield)	Centerra Gold Inc.	Cu, Au, Ag; Alkalic porphyry Cu-Au; 094N 194, 093N 091	na	Geophysics, 640 line-km low altitude aeromagnetic survey, planned 32 line-km IP. Drilling near pit (planned) 25,000 m. Drilling outside ultimate pit, 23 holes, 9900 m.	
Nechako Gold	Tower Resources Ltd.	Au, Ag; Epithermal, low sulphidation; 093F 060	na	Drilling, RC, 11holes in till to help define sulphide mineral dispersal. Results used to select sites for seven DDH. Results included 0.2 m grading 2.93 g/t Au, 34.3 g/t Ag, 5.45% Zn, 0.60% Pb.	
Safari	Spearmint Resources Inc.	Cu-Au; Alkalic porphyry Cu-Au	na	Rock sampling. Two of 17 grab samples returned assays of 0.23% and 0.14% Cu; in addition to anomalous Au and Ag values of 0.3 g/t Au, and 2.7 and 1.0 g/t Ag.	
Snowbird	Gitennes Exploration Inc.	Au; Epithermal in quartz veins; 093K 036	na	Late season drilling, 10 holes, 2000 m.	
Stardust	Sun Metals Corp.	Ag, Pb, Zn; Skarn Ag-Pb-Zn; 093N 009	na	Drilling, estimated 27 holes, 15,000 m. Results included 24.85 m of 3.13% Cu, 4.8 g/t Au, and 93.45 g/t Ag, and 58.01 m of 2.49% Cu, 2.61 g/t Au, and 44.3 g/t Ag.	

Table 5. Continued.

Top Cat	Serengeti Resources Inc.	Cu-Au; Alkalic porphyry Cu-Au	na	Mapping, prospecting (79 rock samples), geochemical sampling (282 soil and stream samples). Rock samples returned trace to 6.5 g/t Au.
Wicheeda	Defense Metals Corp.	Carbonatite-hosted deposits Nb, REE; 093J 014	Inf: 11.37 Mt 1.14% Ce, 0.53% La, 0.23% Nd, 0.04% Nb, 0.01% Sm and 1.96% LREE (at a 1% LREE cut- off).	Collected 30 t bulk sample. Drilling, 13 holes, 2005 m. Results included 83 m of 4.43% light rare earth oxides (LREO) and 58 m of 4.01% LREO.

M = Measured; I = Indicated; Inf = Inferred

Table 6. Selected exploration projects, Northeast Region.

Project	Operator (partner)	Commodity; Deposit type; MINFILE	Resource (NI 43-101 compliant unless indicated otherwise)	Comments
17-001 to 17- 003	Sil Industrial Minerals Ltd.	Sand and gravel (as frac sand)	na	Drill sampling, 90 holes, 600 m.
Huguenot	Colonial Coal International Corp.	Coal; Bituminous	M+I: 132.0 Mt (in situ surface mineable)	Released a Preliminary Economic Assessment.

M = Measured; I = Indicated; Inf = Inferred



Fig. 3. Lawyers project, DDH 19AGBDD001, 233 m, gold mineralized silica-flooded hydrothermal breccia.

1361 g/t Ag at the AGB zone, 2.87 m grading 46.9 g/t Au and 3056 g/t Ag at the Phoenix zone and 3.34 m grading 7.85 g/t Au and 830 g/t Ag at the Duke's ridge zone. Lower grade envelopes around high-grade vein sets may indicate potential for a bulk tonnage resource. Surface sampling identified a new zone (Marmot East) across an area of 500 by 250 m where rock grab samples graded up to 24.2 g/t Au and 1425 g/t Ag.

7.1.4. Snowbird (Gitennes Exploration Inc.)

The **Snowbird** project is an orogenic gold-in-quartz deposit that has seen at least 10 years of exploration. It is about 2 km to the north of the Snowbird antimony (stibnite) former mine. Vein and shear zone mineralization is hosted by argillite, alpine-type ultramafic rocks (harzburgite), andesite, and diorite along the Sowchea fault zone. Gitennes has explored the property since 2016, and in 2019 completed late-season diamond drilling totalling 2000 m in 10 holes. The deepest hole (400 m) intersected pyrite-arsenopyrite associated with quartz-carbonate veins.

7.2. Selected porphyry projects

Porphyry projects continued to be the principal focus of mineral exploration in the Quesnel and Stikine terranes of the North Central Region (Fig. 1; Table 5).

7.2.1. Atty (Serengeti Resources Inc.)

Serengeti's **Atty** project is adjacent to Centerra Gold's Kemess property. In 2019, 29.8 line-km of IP geophysics and follow up diamond drilling (six holes, 2318 m) were carried out. Highlight drilling results included 87.7 m of 0.04% Cu, 0.14 g/t Au and 0.4 g/t Ag.

7.2.2. Captain (Orestone Mining Corp.)

The **Captain** project is 30 km south of the Mt. Milligan mine. Mineralization is hosted in an altered akalic monzonite porphyry. In 2019, Orestone completed 1900 m of diamond drilling in seven holes. The holes intersected intervals with sericite alteration and 10-20% very fine disseminated sulphides, including chalcopyrite. Highlight results included 91 m of 0.065% Cu and 0.26 g/t Au.

7.2.3. Chuchi (Centerra Gold Inc.)

The **Chuchi** copper-gold property is at the northeast margin of the Hogem batholith (Early Jurassic to Early Cretaceous), where a cluster of porphyritic monzonite stocks, dikes, and sills intrude the Chuchi Lake succession of volcanic and sedimentary rocks. In 2019, Centerra carried out a 731 linekm low-altitude aeromagnetic survey and 1755 m of diamond drilling in 4 holes.

7.2.4. Croy-Bloom (Serengeti Resources Inc.)

The **Croy-Bloom** property hosts several Cu-Au porphyry targets. The property is underlain by Middle to Upper Triassic volcaniclastic and volcanic rocks of the Takla Group that are cut by intrusive bodies that comprise the northern end of the Hogem batholith. In 2019, Serengeti completed about 12 line-km of IP surveying, mapping, and sampling.

7.2.5. Fran (MGX Minerals Inc.)

MGX carried out a winter 2018-2019 drilling program at its **Fran** project alkalic porphyry target. The target is hosted by volcano-sedimentary rocks of the Takla Group that are cut by en-echelon shear zones containing quartz-sulphide veins and stockworks. In 2019, MGX diamond drilled 4200 m in 11 holes. Highlight results included 1.3 m of 13.5 g/t Au, 2.23 m of 23.26 g/t Au and 8.85 m of 1.0 g/t Au.

7.2.6. Kwanika (Kwanika Copper Corporation)

Kwanika Copper Corporation (65% Serengeti Resources Inc., 35% Posco International Corporation) was formed in 2017 to continue exploration on the **Kwanika** property. Since 2006, about 82,650 m of drilling has been done on Kwanika (Central and South zones). In 2019, an updated combined open-pit and underground constrained Central Zone resource was announced as a Measured and Indicated resource of 223.6 Mt grading 0.27% Cu, 0.25 g/t Au and 0.87 g/t Ag containing 1.32 Blbs of Cu, 1.83 Moz of Au and 6.27 Moz of Ag. The company planned to release a prefeasibility study but determined that it lacked the necessary funding and instead will focus on completing an interim study report.

7.2.7. Mt. Milligan Brownfield and Greenfield Programs (Centerra Gold Inc.)

Centerra carried out a brownfield-greenfield low-altitude 640 km aeromagnetic survey and planned a 32 line-km IP survey near the mine site. Centerra reported that they had planned to complete 22,500 m of near-pit infill drilling by the end of 2019. Additional brownfield drilling (within mine lease, but outside ultimate pit) of 23 holes totalling 9900 m was completed.

7.2.8. Safari (Spearmint Resources Inc.)

The **Safari** project property is adjacent to Serengeti Resources Inc.'s Kwanika project. In 2019, Spearmint carried out rock sampling and two of 17 grab samples returned assays of 0.23% and 0.14% Cu; in addition to anomalous Au and Ag values of 0.3 g/t Au, and 2.7 and 1.0 g/t Ag. Mineralization occurs in quartz veins with pyrite and chalcopyrite sulphides spatially associated with propylitic and potassic altered granitoids.

7.2.9. Top Cat (Serengeti Resources Inc.)

In 2019, Serengeti carried out mapping, prospecting, and geochemical sampling at its **Top Cat** project. In total, 79 rock and 282 soil and stream-sediment samples from six prospective localities were collected. Copper mineralization, in the form of chalcopyrite and/or bornite, was observed at all six localities. Gold assays from trace to 6.50 g/t Au were returned from the sampling.

7.3. Selected polymetallic base and precious metal projects

Exploration was carried out on several polymetallic base and precious metal projects, all in the North Central Region (Fig. 1; Table 5). These include ZincX Resources Corp.'s **Akie** project; Prophecy Potash Corp.'s **Indata** project; InZinc Mining Ltd.'s **Indy** project; Tower Resources Ltd.'s **Nechako Gold** project; and Sun Metal's Corp.'s **Stardust** project.

7.3.1. Akie (ZincX Resources Corp.)

ZincX Resources continued exploration on its Akie SEDEX project, which incudes the Cardiac Creek deposit. The deposit is hosted by siliceous, carbonaceous, fine-grained siliciclastic rocks of the Gunsteel Formation (Middle to Late Devonian). At a base case 5% zinc cut-off, the deposit has an Indicated resource of 22.7 Mt grading 8.32% Zn, 1.61% Pb and 14.1 g/t Ag and an Inferred resource of 7.5 Mt grading 7.04% Zn, 1.24% Pb and 12.0 g/t Ag. In 2019, ZincX carried 2347 m of diamond drilling in four holes, focussing on the high-grade core of the deposit. Highlight results included 10.94 m (true width) of 10.85% Zn, 2.23% Pb and 17.0 g/t Ag and 14.65 m (true width) of 16.20% Zn, 3.39% Pb and 27 g/t Ag.

7.3.2. Indata (Prophecy Potash Corp.)

The **Indata** project is under option from Eastfield Resources Ltd. To earn 60%, Prophecy is required to complete \$2.0 million in exploration, pay \$250,000 in cash and \$150,000 in cash/share equivalents over a five-year term. Imperial Metals Corporation holds an 8.5% working interest (subject to dilution). In 2019, exploration included prospecting and rock sampling, geochemical sampling, road construction, and excavator trenching. Rock grab sample results included 3.64% Cu and 5.95 g/t Au.

7.3.3. Indy (InZinc Mining Ltd.)

The **Indy** project area has been of exploration interest since the early 1980s. Targets have generally been categorized as a Mississippi Valley-type (MVT), although SEDEX affinities have long-been recognized. A maiden drill program in 2018 identified a new SEDEX mineralized discovery (B-9 zone) and results included 6.29 m of 12.33% Zn, 2.98% Pb and 24.5 g/t Ag. In 2019, soil geochemical surveys (1194 samples), mapping and prospecting were carried out. Results identified several targets, the largest being a 1.5 km-long multi-element geochemical target defined by distinctive SEDEX pathfinder elements in soil samples and rock exposures. This target is 5 km northwest of the B-9 zone.

7.3.4. Nechako Gold (Tower Resources Ltd.)

Tower Resources **Nechako Gold** project is approximately 30 km northeast of the advanced Blackwater project. In the spring of 2019, Tower Resources did RC drilling in 11 holes to collect till samples to better define the dispersal train of sulphide minerals identified by previous drilling. Results were used to select seven sites for diamond drilling in totalling 631 m. Drilling intersected brecciated basalt with narrow veins mineralized with sphalerite and galena. The widest vein (0.2 m) assayed 2.93 g/t Au, 34.3 g/t Ag, 5.45% Zn and 0.60% Pb.

7.3.5. Stardust (Sun Metals Corp.)

The Stardust property was acquired by Sun Metals in 2017. Historically regarded as a skarn deposit, it was explored intermittently for many years. Historic work included more than 80,000 m of drilling, 5800 soil samples, airborne magnetic surveys, mapping, and prospecting. Mineralization is hosted by the Sowchea, Pope and Copely successions west of the Pinchi fault, in the Cache Creek terrane. In 2018, Sun Metals reported discovering a new zone (421 zone) and drilling results included a 100 m intersection grading 2.51% Cu, 3.03 g/t Au and 52.5 g/t Ag. Sun Metals began drilling in May 2019, which continued into the fall with plans for extension into 2020. Estimated drilling for 2019 was 15,000 m in 27 holes. Highlight 2019 results for the 421 zone (Fig. 4) included 24.85 m of 3.13% Cu, 4.8 g/t Au and 93.45 g/t Ag, and 58.01 m of 2.49% Cu, 2.61 g/t Au and 44.3 g/t Ag. Results confirm continuity of mineralization down dip and to the south of the 2018 discovery hole.



Fig. 4. Stardust project, DDH 19-SD-430P, 579 m, chalcopyrite and pyrite.

7.4. Selected Ni-Cu-Co-precious metal projects

FPX Nickel Corp.'s **Decar** project is in the North Central Region (Fig. 1; Table 5).

7.4.1. Decar (FPX Nickel Corp.)

The **Decar** project contains ultramafic rocks mineralized with a naturally occurring nickel-iron alloy called awaruite. FPX Nickel Corp. reported bench-scale test results for metal extraction and are considering testing a 10,000 t bulk sample. A conventional flow sheet based on grinding, magnetic separation, and flotation processes consistently produced clean nickel concentrates grading 63 to 65% Ni with significant improvements in recovery relative to previous testing. By-product iron ore concentrates graded 60 to 65% Fe.

7.5. Selected specialty metal projects

Deep-water basin strata east of the Rocky Mountain Trench host a number of specialty metal projects, including Taseko Mine Ltd.'s **Aley** Nb-bearing carbonatite proposed mine (see section 6.1.1.) and Defense Metals Corporation's **Wicheeda** (LREE) project (Fig. 1; Table 5).

7.5.1. Wicheeda (Defense Metals Corp.)

The **Wicheeda** carbonatite is a deformed intrusion that hosts light rare earth elements (LREE) in the Kechika Group. The core of the intrusion is a dolomite carbonatite, which transitions outward to a calcite carbonatite. Hydrothermal veins and plugs in the dolomite carbonatite are mineralized with REE flourocarbonates, ancylite (cerium, lanthanum) and monazite (cerium, lanthanum, neodymium). Minor concentrations of niobium are present as well.

In 2019, Defense Metals completed a 30 t bulk sample and in June released a NI 43-101 report that set out, at a 1% LREE cutoff, an Inferred resource of 11.37 Mt grading 1.14% Ce, 0.53% La, 0.23% Nd, 0.04% Nb, 0.01% Sm and 1.96% LREE. In September, the company completed drilling a total of 2005 m in 13 holes (Fig. 5), which left the deposit open to the north and west. Highlight results included 83 m of 4.43% light rare earth oxides (LREO; lanthanum, neodymium, praseodymium, and samarium oxides) and 58 m of 4.01% LREO.



Fig. 5. Wicheeda project, DDH WI19-21, 57 m, REE-mineralized carbonatite.

7.6. Selected coal projects

Exploration for coal in the Northeast Region remained at low levels except at active mine sites. Colonial Coal International Corp. announced a revised Preliminary Economic Assessment for its Huguenot project (Fig. 1; Table 6).

7.6.1. Huguenot (Colonial Coal International Corp.)

Colonial Coal announced a Preliminary Economic Assessment for an open-pit only mine for its Huguenot project. This revises a previous PEA for a combined open-pit and underground operation. Two scenarios for the open-pit only mine capital expenditures were reported. Based on the purchased equipment scenario the financial analysis suggested that the coal price required to achieve a zero NPV at discount rates of 5%, 7.5% and 10%, respectively, is about US\$113, US\$120 and US\$125 t. A coal price of US\$137 per t is required for an IRR of 15%. Based on the leased equipment option the financial analysis suggested that the coal price required to achieve a zero NPV at discount rates of 5%, 7.5% and 10%, respectively, is about US\$114, US\$119 and US\$125 per t. A coal price of US\$137 per t is required for an IRR of 15%. Measured and Indicated surface mineable coal resources total 132.0 Mt, with an additional Inferred resource of 0.5 Mt. The conceptual open pit would yield 72 Mt of product coal during a mine life of 27 years.

7.7. Selected industrial mineral projects

Apart from the proposed **Giscome** limestone quarry (see section 6.3.1.), the only significant industrial mineral project was in the Northeast Region, where Sil Industrial Minerals explored for frac sand resources at its **Sil** project (Fig. 1; Table 6).

7.7.1. Sil 17-001 to 17-003 (Sil Industrial Minerals Ltd.)

In 2018, Sil Industrial Minerals Ltd. completed initial exploration in the Northeast Region on a multi-year project in search of frac sand resources in post-glacial sediments. In 2019, the 17-001 target area was sampled with 70 drill holes totalling 500 m, the 17-002 target area was sampled with 10 drill holes totalling 50 m and the 17-003 target area was also sampled with 10 drill holes totalling 50 m.

8. Geological research

Ootes et al. (2020 a, b) conducted the second year of a threeyear project mapping northern Hogem batholith and surrounding rocks, refining plutonic suite assignments, providing new geochronologic data, and reporting new mineral showings. As an aid to mapping the surficial and bedrock geology of the area, Elia and Ferbey (2020) used a remotely piloted aircraft to produce high-resolution digital elevation models that provided details in near real-time about map units that field crews would not otherwise have gained. Steinthorsdottir et al. (2020) examined serpentinized ultramafic rocks of the Trembleur ultramafite near Decar to better understand controls on the formation, distribution, and abundance of brucite, which is capable of sequestering atmospheric CO_2 , and awaruite, a potential source of nickel. Nott et al. (2020) examined the geology and geochronology of the Polaris ultramafic-mafic complex to better understand Ni-CU-PGE ore-forming processes in such Alaskan-type intrusions.

9. Summary

The North Central and Northeast regions are highly prospective for discovering mineral deposits. The North Central Region has three proposed metal mine projects and one proposed industrial mineral mine project. The Northeast Region has several proposed coal mine projects and one proposed industrial mineral mine project. The North Central Region has several active mineral exploration projects while in the Northeast Region the predominant commodity explored for is coal. In 2019, exploration expenditures were down slightly in both regions.

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Exploration and mining in the South Central Region, British Columbia

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1. Introduction

With four major mines, the South Central Region is currently the most productive copper mining district in Canada. In addition, an underground gold mine restarted in 2017. 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 six major proposed metal mines. About 80 exploration projects were tracked in 2019, although this represents a minimum because not all exploration work is recorded, and 2019 work that must be recorded for regulatory compliance is not necessarily reported in the calendar year.

Exploration expenditures for the region are estimated at \$54.5 million; exploration drilling is estimated at 197,100 m (Clarke et al., 2020; EY LLP, 2020).

Several advanced properties changed hands during the year. Notably, Osisko Gold Royalties Ltd. acquired Barkerville Gold Mines Ltd. and its **Cariboo Gold** project, Bayshore Minerals Ltd. bought the **Elk** project from Equinox Gold Corp., Taseko Mines Limited acquired Yellowhead Mining Inc. and its Harper Creek (now **Yellowhead**) project, and Talisker Resources Ltd. purchased Bralorne Gold Mines Ltd. (which operates the **Bralorne** project). From Avino Silver & Gold Mines Ltd. Tempus Resources Limited acquired Sona Resources Corp., formerly a subsidiary of Skeena Resources Limited, which holds the **Blackdome-Elizabeth** project.

Total area under tenure in the region increased about 6% between October 2018 and November 2019 to nearly 2.6 million ha.

2. Geological overview

The tectonic and metallogenic evolution of the Canadian Cordillera are intimately linked (Fig. 1, e.g., Colpron and Nelson, 2011; 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 Neoproterozic 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 Fig. 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 Devono-Mississippian calc-alkaline to alkalic volcanic rocks and associated granitoid intrusions, found mainly in the Eagle Bay assemblage (Schiarizza 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, represented by the Harper Ranch Group (Beatty et al., 2006) and,



Fig. 1. Mines and selected exploration projects, South Central Region, 2019. Terranes after Nelson et al. (2013)

in the south, assemblages of oceanic rocks (TempelmanKluit, 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 an eastern sedimentary facies of siltstone and slate intercalated with quartzite and limestone (Bloodgood, 1990; Schiarizza et al., 2013; Mihalynuk et al., 2015; Schiarizza, 2019). The volcanic rocks are mainly augite-phyric shoshonitic basalts, but the western part of the group locally includes a belt of calcalkaline 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 Ouesnel 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, gold from a small mine, 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, operated for part of 2019. 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 (Barkerville Gold Mines Ltd.)

Barkerville 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. Underground development and permitting are underway for the Bonanza Ledge Phase II project, which will exploit the BC Vein for a projected two years at a targeted rate of 650 tpd. About

Mine	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2019 Production (based on Q1- Q3)	Reserves	Resource	Comments
Bonanza Ledge	Barkerville Gold Mines Ltd.	Au; Au-quartz veins; 093H 140	na	na	M: 175,000 t 6.1 g/t Au I: 55,000 t 4.6 g/t Au	Production suspended for underground development and phase 2 permitting. Resource at 3.0 g/t cut off. Excludes BC vein.
Copper Mountain	Copper Mountain Mining Corporation 75%, Mitsubishi Materials Corporation 25%	Cu, Au, Ag; Porphyry Cu- Au, Alkalic; 092HSE001	72-80 Mlb Cu, 29,500- 32,500 oz Au, 260,000- 290,000 oz Ag (management's guidance)	P+Pr: 476,795,000 t 0.23% Cu, 0.10 g/t Au 0.73 g/t Ag	M+I: 598,850,000 t 0.23% Cu, 0.10 g/t Au, 0.73 g/t Ag	0.10% Cu cut- off. Resources inclusive of reserves. Includes New Ingerbelle.
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+Mo (+/-5%) (management's guidance)	P+Pr: 594 Mtons 0.25% Cu, 0.008% Mo	M+I:1109 Mtons 0.25% Cu, 0.007% Mo Inf: 59 Mtons 0.21% Cu, 0.004% Mo	0.15% Cu cut- off. Resources inclusive of reserves. Does not include Cu oxide.
Highland Valley	Teck Resources Limited	Cu, Mo; Porphyry Cu+/- Mo+/-Au; 092ISW012, 45	115,000- 120,000 t Cu, 8.0 Mlb Mo (management's guidance)	P+Pr: 535.5 Mt 0.300% Cu, 0.007% Mo	M: 499.4 Mt 0.30% Cu, 0.008% Mo I: 671.8 Mt 0.24% Cu, 0.009% Mo Inf: 166.0 Mt 0.21% Cu, 0.007% Mo	Resources exclusive of reserves. Evaluating plans for extension of mine life.
Mount Polley	Imperial Metals Corporation	Cu, Au, Ag; Porphyry Cu- Au, Alkalic; 093A 008	3.825 Mlb Cu 10,619 oz Au 11,119 oz Ag (to shut down)	P+Pr: 53.772 Mt 0.337% Cu, 0.299 g/t Au, 0.89 g/t Ag	M+I: 194.32 Mt 0.294% Cu 0.285 g/t Au, 0.727 g/t Ag Inf: 5.619 Mt 0.374% Cu, 0.276 g/t Au, 2.187 g/t Ag	Reserves in 5 zones. Resources inclusive of reserves. Shut down mid year pending improved copper price.
New Afton	New Gold Inc.	Au, Ag, Cu; Porphyry Cu- Au, Alkalic; 092INE023	215-246 koz AuEq (management's guidance)	P+Pr: 52.642 Mt 0.64 g/t Au, 1.9 g/t Ag, 0.78% Cu	M+I: 52.407 Mt 0.63 g/t Au, 2.2 g/t Ag, 0.77% Cu Inf: 13.564 Mt 0.39 g/t Au, 1.4 g/t Ag, 0.45% Cu	Resources exclusive of reserves. Ongoing exploration program.

Table 1. Metal mines, South Central Region.

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

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 commence Phase II production.

Two types of mineralization are of interest at Bonanza Ledge: pyrite replacement and vein mineralization consisting of native gold in quartz veins in 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 been producing since August 2011 and mills at a rate of close to 40,000 tpd. Planned addition of a third ball mill in 2020 would increase it to 45,000 tpd. Expected production in 2019 is at the lower end of guidance of 72-80 Mlbs Cu, 29.5-32.5 koz Au, and 260-290 koz Ag. In the first three quarters it produced 53.362 Mlbs Cu, 20,547 oz Au, and 185,212 oz Ag.

Approximately 15,000 m of drilling at **Copper Mountain** in 2019 was directed at searching for resources close to existing reserves. Following 2017-2018 drilling at New Ingerbelle, in 2019 Copper Mountain Mining Corporation converted resulting resources to reserves. Additional work then further increased reserves at the New Ingerbelle, North Pit and Main Pit. Expected mine life is now 31 years based on current reserves and planned production level.

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) described the deposit as a structurally complex 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 was projected to produce approximately 130 Mlb Cu in 2019. By the end of the third quarter, it had produced 92.5 Mlb Cu and just more than 2 Mlb Mo. Reserves updated in November (Table 1), support a projected 19-year mine life. Taseko has a multi-year permit for exploration north and northwest of the mine.

Ore comes from five pits (Connector, Gibraltar, Granite, Extension, and Pollyanna), but not all operate at all times. The calc-alkaline porphyry Cu-Mo deposit is in the Granite Mountain batholith (Upper Triassic; see van Straaten et al., 2013) in a fault-bounded section of Nicola Group and Dragon Mountain succession volcanic and sedimentary rocks (Quesnel terrane; Schiarizza 2014, 2015) 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** copper-molybdenum mine (Fig. 1; Table 1) comes from the Valley and Lornex pits, two of seven in the camp. Projected 2019 production is 115,000-120,000 t Cu and 8 Mlbs Mo in concentrate. Three-year guidance (2020-2022) is 135,000-155,000 t/y Cu and 4.0-5.0 Mlbs/y Mo. This is in anticipation of changing ore characteristics and ramping up of a recently installed ball mill.

Mining began 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 approximately 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 calk-alkaline Cu-Mo type in the Guichon Creek batholith (Upper Triassic), which has been divided into a number of pre-, syn- and post-mineral phases (see Byrne et al., 2013).

3.1.5. Mount Polley (Imperial Metals Corporation)

Mount Polley is a 20,000 tpd open-pit operation that also has underground resources (Table 1). In January 2019, Imperial announced a decision to stop mining and mill low-grade stockpiles before suspending production. They placed the mine on care and maintenance at the end of May. Production to May 26 was 3,825,000 lbs Cu, 10,619 oz Au and 11,119 oz Ag from 2,231,119 t ore milled.

Rehabilitation work on Hazeltine Creek continued. Exploration may also proceed on lease and on nearby properties. Imperial is proposing an IP survey north of the mine site and has optioned adjacent properties from Commander Resources Ltd.

The mine may restart when copper prices warrant. 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 2014-2015.

The deposits exploited 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. Rees (2013) and Brown et al. (2016) provide reviews of **Mount Polley** geology and mineralization.

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.

New Afton produced 61.2 Mlbs copper and 53,051 oz Au the first three quarters of 2019. Guidance for the year is 215,000 to 245,000 Au equivalent oz, or approximately 75-85 Mlbs Cu and 55,000-65,000 oz Au including Ag by-product.

New Gold Inc. has been drilling deep mineralization at **New Afton** in the westward extension of the SLC zone and in the D-zone target down plunge of the C-zone reserves. The C-zone itself is expected to extend mine life to 2030. They also reported surface geophysics (IP) and geochemistry work to identify drill targets along the Cherry Creek trend within 3 km WNW of the New Afton Mill. They propose drilling at up to 100 sites.

The targets and deposits are alkalic porphyry Cu-Au, hosted by the Iron Mask batholith and volcanic and volcaniclastic rocks of the Nicola Group (Upper Triassic).

3.2. Selected industrial mineral mines

More than a dozen industrial mineral quarries and processing plants are in the region (Fig. 1; Table 2). These operations employ more than 250 people. In addition, nearly 300 sand and gravel pits and 45 quarries have active Mines Act permits. Many of these 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.

3.2.2. Decor (Pacific Bentonite Ltd.)

The **Decor** pit of Pacific Bentonite Ltd. was a supplier of alumina-rich burnt shale to the Lafarge cement plant in Kamloops. This operation is now on care and maintenance because of the Lafarge plant's shutdown. The Decor property also hosts a large bentonite deposit, which has been investigated for other applications.

3.2.3. 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.

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

Decorative rock and dimension stone are produced at small quarries throughout the region. Kelowna Sand and Gravel Ltd. mines gneiss, dacite ash, 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.

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

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

3.2.6. Bromley Creek (Canadian Zeolite Corp.)

In 2014, Canadian Mining Company Inc. a subsidiary of Canadian Zeolite, concluded its option agreement with Heemskirk Canada Ltd and regained control of the **Bromley Creek** zeolite quarry. Zeolite from the quarry has agricultural and absorbent applications. Mining is by Absorbent Products Ltd.

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 lack production data.

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

Mine	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2019 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)	Canadian Zeolite Corp.	Zeolite; Open system zeolites; 092HSE243	na	na	M+I: (as of 2013-06-30): 550,000 t	Operated by Absorbent Products Ltd.
Bud	Absorbent Products Ltd.	Bentonite; 092HSE162	na	na	na	Operating, but volumes not published.
Decor	Pacific Bentonite Ltd.	Alumina, Landscape rock; 092INW084	na	na	na	
Falkland	Lafarge Canada Inc.	Gypsum; 082LNW001	na	na	na	Production affected by shut down of Lafarge's Kamloops Cement Plant.
Harper Ranch	Lafarge Canada Inc.	Limestone; 092INE001	na	na	na	On care and maintenance as of November 2016.
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	Active 2019.
Mount Polley Magnetite	Craigmont Industries Ltd.	Magnetite (recovered from tailings); 093A 008	na	na	na	Mount Polley suspended.
Nazko	Can Lava Mining Corporation	Lava Rock; Cinder cone; 093B 060	na	na	Historical: 45 Mt	1998 resource estimate. Exploration permitted on adjacent property.
Pavilion	Graymont Western Canada Inc.	Limestone; 092INW081	na	na	na	On care and maintenance as of June 2016. In reclamation.
Red Lake	Absorbent Products Ltd.	Diatomaceous earth; Lacustrine diatomite; 092INE081	na	na	na	Operating, but volumes not published.
Z-1	ZMM Canada Minerals Corp.	Zeolite; Open system zeolites; 092INW095	na	na	Approx. 800,000 t	Historical resource.

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

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

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reviewed by an interagency Mine Development Review Committee (MDRC) chaired by the Ministry of Energy, Mines and Petroleum Resources. Seven projects are in this category: **Ajax**, **Bralorne**, **Cariboo Gold**, **New Prosperity**, **Ruddock Creek**, **Spanish Mountain**, and **Yellowhead** (Fig. 1; Table 3). Of these, Yellowhead's environmental assessment has terminated, Ajax's rejected by both levels of government, and New Prosperity's provincial certification may expire in early 2020. 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.

6.2. Bralorne (Bralorne Mines Ltd.)

In December, Talisker Resources Ltd. closed its acquisition of Bralorne Mines Ltd., a subsidiary of Avino Silver & Gold Mines Ltd. The cash and shares deal includes a payment of \$8.7 million. Avino acquired the Bralorne gold mine in 2014 and suspended mining shortly thereafter because the tailings storage facility reached capacity. The mine had been operating at a 100 tpd trial basis between 2010 and 2014. Since then, Avino has carried out upgrades and plan to meet permitting requirements. In 2017, they received an updated permit for a 100 tpd throughput mining operation. Avino anticipates operating the mine at more than 100 tpd. However, they report that much of their existing infrastructure is inadequate for higher throughput and they are proceeding with redevelopment. The dam for tailings storage was raised in 2015 and the impoundment buttressed in 2016. A new water treatment plant was built in 2016, electrical systems upgraded, and retired equipment and buildings removed or demolished.

Within the new permit boundary, exploration continued, including 28,000 m of drilling, which began in 2018 and extended through 2019. The two-phase program included an under-explored area called the NorthEast block. Reporting gold-bearing veins in 27 of 35 holes, the company considers that the area has greater potential than previously recognized.

Between 1928 and 1971, the Bralorne camp produced 4.15 Moz Au at average grades of about 15 g/t. Veins have characteristics typical of orogenic gold deposits; the age of mineralization is estimated at ca. 68-64 Ma (40 Ar/ 39 Ar muscovite; Hart and Goldfarb, 2017).

6.3. Cariboo Gold (Barkerville Gold Mines Ltd.)

In November of 2019, Osisko Gold Royalties Ltd acquired all shares in Barkerville Gold Mines Ltd. they did not already own. The deal valued Barkerville at about \$338 million. Barkerville submitted a project description to the British Columbia Environmental Assessment Office, which then issued a section 10 order requiring the project to obtain an Environmental Assessment Certificate to proceed. A 2019 preliminary economic assessment studied a 4000 tpd underground mine beneath Cow Mountain, Island Mountain, and the Valley zone in between. Reserves of 14.7 Mt at 4.5 g/t Au average diluted gold grade would give an expected 11-year mine life. Assuming a base case gold price of US \$1325/oz and C\$1.00=US\$0.77, the study estimated an internal rate of return of 28.1% and net present value of C\$402.2 million at a discount rate of 5%.

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 is ongoing with about 91,000 m drilling in 2019 at Cow Mountain (including newly discovered Lowhee zone), Island Mountain (Mosquito and Shaft zones) and Barkerville Mountain. Mineralization is orogenic vein and replacement type and Allan et al. (2017) reported ages of mineralization from 148-135 Ma (⁴⁰Ar/³⁹Ar muscovite).

6.4. New Prosperity (Taseko Mines Limited)

The **New Prosperity** project of Taseko Mines Limited, is a porphyry gold-copper deposit with Proven and Probable reserves of 830 Mt grading 0.42 g/t Au and 0.23% Cu. Taseko continues to seek a judicial review of the February 2014 federal decision to deny the project. British Columbia granted Taseko a project certificate in 2010 and extended its expiry date by five years to 2020. In 2017, the British Columbia Ministry of Energy, Mines and Petroleum Resources issued a permit for a detailed site investigation of proposed mine infrastructure.

Most of the 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 the 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 the work.

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 grading 0.29% Cu; 0.19 g/t Au; 0.39 g/t Ag	M+I (NSR cut- off US\$7.10/t): 568 Mt grading 0.26% Cu; 0.18 g/t Au; 0.35 g/t Ag	Environmental certification denied by provincial (2017) and federal ministers (2018).
Bralorne	Avino Silver and Gold Mines Ltd. (Talisker Resources Ltd. acquiring Bralorne Gold Mines Ltd.)	Au; Au-quartz veins; 092JNE001	na	577,559 t 9.6 g/t Au	Past producer 1900-1971. Operated on a trial basis 2010- 2014. Updated 100 tpd permit in 2017. Exploration in 2018- 2019 included drilling, airborne and ground geophysics, mapping, and geochemical sampling.
Cariboo Gold Project	Barkerville Gold Mines Ltd. (acquired by Osisko Gold Royalties Ltd.)	Au; Au-quartz veins; 093H 140, 139, 19, 6	na	M+I (cut-off 3.0 g/t Au): 13.495 Mt 5.6 g/t Au Inf (3.0 g/t cut- off): 11.936 Mt 5.0 g/t Au	PEA has u/g mine with 11-year mine life, average 185,000 oz/y Au. In EA pre-application stage. Exploration continued with 91,000 m drilling.
New Prosperity	Taseko Mines Limited	Cu, Au; Porphyry; 092O 041	P+Pr (NSR cut-off \$5.50/t): 831 Mt grading 0.23% Cu and 0.41 g/t Au; containing (recoverable) 3.6 Blb Cu; 7.7 Moz Au	M+I (cut-off 0.14% Cu): 1010 Mt grading 0.24% Cu; 0.41 g/t Au	Project at post-decision stage. Granted provincial environmental certificate but denied federal approval. Exploration and site evaluation proposed in 2019 but deferred pending a new legal challenge.
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 grading 6.50% Zn, 1.33% Pb	Project at environmental assessment pre-application stage. Exploration drilling continued in 2019. Highlight 40.9 m 16.83% Zn, 3.46% Pb, 4.74 g/t Ag. Japan Oil, Gas and Metals National Corporation earning an interest.
Spanish Mountain	Spanish Mountain Gold Ltd.	Au, Ag; Au-quartz veins; 093A 043	na	M+I (cut-off 0.15 g/t Au): 273.2 Mt grading 0.47 g/t Au; 0.71 g/t Ag Inf: 52.4 Mt 0.37 g/t Au, 0.67 g/t Ag	Project at environmental assessment pre-application stage. Preliminary economic assessment updated in 2019.
Yellowhead	Taseko Mines Limited	Cu, Au, Ag; Noranda/Kuroko; 082M 008, 9	P+Pr (cut-off 0.14% Cu): 716 Mt grading 0.26% Cu; 0.029 g/t Au; 1.18 g/t Ag	M+I (cut-off 0.2% Cu) 815 Mt 0.28% Cu; 0.030 g/t Au; 1.3 g/t Ag	BC Environmental Assessment Office terminated EA process 2018. Taseko Mines Limited acquired the project and plans to advance it.

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

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

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6.5. 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 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. JOGMEC funded the 2019 program and their share in the venture increased.

The deposit is described as sedimentary exhalative, Monashee or Broken Hill-type, in marble, gneiss, and calc-silicate rocks. The joint venture operators followed up on positive 2018 results by drilling a total of 8800 m in 17 holes on the Q and V zones at the western edge of the **Ruddock Creek** massive sulphide prospect. A highlight from the deep V zone was 40.9 m grading 16.83% Zn, 3.46% Pb and 4.74 g/t Ag.

6.6. Spanish Mountain (Spanish Mountain Gold Ltd.)

Spanish Mountain updated their preliminary economic assessment, evaluating an initial, optimized phase that would focus on a central, pit-constrained near-surface area of the deposit. The larger Measured and Indicated resources are 273.2 Mt grading 0.47 g/t Au, 0.71 g/t Ag. In this 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 project has been in the pre-application phase of environmental assessment since 2011. Current efforts are directed more toward optimization studies than environmental certification.

The **Spanish Mountain** deposit consists of disseminated gold in graphitic argillite and gold-bearing quartz veins in siltstone, greywacke, and tuff. Host rocks are Upper Triassic and mineralization is Late Jurassic, older than that at the Cariboo Gold project (Allan et al., 2017). Spanish Mountain is typically compared to sediment-hosted vein deposits.

6.7. 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 evaluating advancing it. A 2014 feasibility study considered a 70,000 tpd open-pit mine with a 28-year life, based on Proven and Probable reserves of 716.2 Mt at 0.26% Cu, 0.029 g/t Au and 1.18 g/t Ag.

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. Selected exploration activities and highlights

In 2019, as in 2017 and 2018, the largest exploration project in the region was Barkerville Gold Mines Ltd.'s **Cariboo Gold** (see section 6.3.). Avino Silver & Gold Mines Ltd. continued drilling at **Bralorne**, (see section 6.2.). Westahaven Ventures Inc. followed last year's discovery 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, cobalt-bearing veins, 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.

7.1.1. Shovelnose (Westhaven Ventures Inc.)

Westhaven focussed on drilling the **Shovelnose** lowsulphidation epithermal prospect again in 2019 with a planned 20,000 m program. They are on track to reach that target by the end of the year. They have now identified three northwesttrending gold-bearing vein zones at the South Zone (Fig. 2). Vein zone 1 has been extended along strike for about 1000 m with a vertical extent of 300 m. Zone 2 has a 460 m strike length and zone 3 has a 170 m strike length. The company also reported seven new epithermal targets, including drill targets outside the South Zone, resulting from prospecting, ground magnetic (327 line km), soil (more than 6000 samples) and resistivity surveys (18 km).



Fig. 2. Quartz, chalcedony and adularia veining with ginguro (black) in lapilli tuff at Westhaven Ventures Inc.'s Shovelnose project.

7.1.2. Lac La Hache (Engold Mines Ltd.)

Engold Mines Ltd. drilled its Lac La Hache project in early 2019, stepping out at the Aurizon target. Initial results extended narrow quartz-carbonate gold veins along strike. Engold resumed drilling late in the year and carried out soil surveys on

Project	Operator (partner)	Commodity; Deposit type; MINFILE	Resource (NI 43-101 compliant unless indicated otherwise)	Comments
Amarillo	Troubadour Resources Inc.	Cu; L04:Porphyry Cu±Mo±Au; 082ENW108	na	Mapping, sampling, drilling 1075 m in 4 holes.
BC Cobalt	Blackstone Minerals Ltd.	Co, Au; I14:Five-element veins Ni-Co-As- Ag+/-(Bi, U); 092JNE068, 108	na	Mapping, stream sediment and soil sampling.
Big Kidd	Jiulian Resources Inc.	Cu, Ag, Au; L03:Porphyry Cu-Au; 092HNE072, 73, 74, 109	na	Drilling 4191.5 m in 9 holes.
Blackdome- Elizabeth	Tempus Resources Ltd.	Au, Ag; I01:Au- quartz veins, H05:Epithermal Au-Ag-Cu low- sulphidation; 0920 053, 012	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	Tempus acquired Sona Resources Corp. Initial soil sampling, update of resource estimate. Notice of Work for drilling in process.
Black Duck	Karam Minerals Inc.	Au, Ag; I01:Au-quartz veins; 092P 092	na	Till and soil samples.
Donna	Pinnacle North Gold Corp. (Eagle Plains Resources Ltd.)	Au, Ag; I05:Polymetallic veins; 082LSE022, 10, 20, 16	na	One hole drilled. Further work permitted.
Elk	Bayshore Minerals Inc.	Au, Ag; I01:Au- quartz veins; 092HNE009, 295, 41, 261	M+I: 1,042,600 t 6.32 g/t Au Inf: 1,096,900 t 5.94 g/t Au	Bayshore is new owner. Airborne geophysics, environmental baseline sampling.
Fairview	Gold Lion Resources Inc.	Cu, Zn, Pb, Ag; I05:Polymetallic veins; 092INW037, 52, 58, 59	na	Airborne magnetic survey (466 km), rock sampling.
Fox	Happy Creek Minerals Ltd.	W; K05:W skarns; 093A 259, 260, 261, 211	I: 582,000 t 0.826% WO ₃ Inf: 565,400 t 1.231% WO ₃	Step-out drilling near Nightcrawler zone. 372.5 m in 2 holes.
Hedge Hog	Surge Exploration Inc.	Cu, Pb, Zn, Co; G05:Cyprus massive sulphide Cu (Zn); 093H 156	na	29 test pits.

 Table 4. Selected exploration projects, South Central Region.

Table 4. Continued.

Iron Lake	GK Resources Ltd.	Cu, Pt, Pd, Au, Co; M05:Alaskan type?; 092P 132, 113, 182, 222	na	IP survey, rock sampling.
Juniper Creek	ZMM Canada Minerals Corp.	Zeolite; D01:Open-system zeolites	na	Bulk sample.
Lac La Hache	Engold Mines Ltd.	Cu, Au, Ag, Fe; L03:Alkalic porphyry Cu-Au, K01:Cu skarn; 092P 120, 108, 2	I: 7.60 Mt 0.28% Cu, 0.05 g/t, 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 Inf: 1.073 Mt 2.480 g/t Au, 0.64% Cu, 5.98 g/t Ag (Aurizon)	Diamond drilling (1276 m, 9 holes), soil sampling. Highlight 6.18 g/t Au, 0.80% Cu and 2.63 g/t Ag across 4.55 m.
Miner Mountain	Sego Resources Inc.	Cu, Au; L03:Alkalic porphyry Cu-Au; 092HSE203, 78	na	Trenching results reported early in the year included 18 m grading 0.96% Cu and 0.31 g/t Au. New drill targets identified.
MPD	Dunnedin Ventures Inc.	Cu, Au; L03:Alkalic porphyry Cu-Au; 092HNE243, 55, 191, 244	na	1766 m diamond drilling in 3 holes. Surface trench sample 0.89% Cu across 46 m.
Merit	Independence Gold Corp.	Au, Ag; H05:Epithermal Au-Ag; 092ISW106	na	Prospecting, rock sampling, ground magnetic survey, metallurgy. Sample highlight 9.5 g/t Au and 341 g/t Ag.
Mont	Leo Lindinger	Bentonite; E06:Bentonite	na	3 drill holes-all intersected bentonite clay.
New Craigmont	Nicola Mining Inc.	Cu, Au; K01:Cu skarn; 092ISE035	na	Results of 2018 drilling released, additional drilling 2019. Highlights 84.00 m 0.34% Cu, 44 m 0.45% Cu, 13.00 m 0.65% Cu with magnetite. Soil geochemistry, mapping.
Nicoamen	Independence Gold Corp.	Au; H05:Epithermal Au-Ag-Cu low sulphidation; 092ISW132, 131	na	Mapping, sampling, ground magnetic survey. Samples grading 3.91 and 4.56 g/t Au.
North Brenda	Bitterroot Resources Ltd.	Au, Ag; I01:Au- quartz veins, J01:Polymetallic mantos?; 092HNE318, 294	na	IP and gravity surveys. New carbonate replacement targets.
Olivine Mountain	GSP Resources Corp.	Cu, Au, Pd; M05:Alaskan type; 092HNE201, 092HSE095, 141, 39	na	Approx. 1200 m in 7 holes.
Pellaire	Blue Lagoon Resources Inc.	Au, Ag; I05:Polymetallic veins	na	Ground magnetic survey, IP, rock geochemistry.

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Table 4. Continued.

Perk-Rocky	Ethos Gold Corp.	Cu, Au; I01:Au- quartz veins, L04:Porphyry?; 092N 011, 12, 53	na	Mapping, rock sampling, stream sediment and talus geochemistry, airborne VTEM and magnetic survey (657 line km).
Princeton Gold	Canarc Resource Corp.	Au; I01:Au- quartz veins; 092HSE262, 263	na	Trenching (500 m), mapping, sampling.
Rateria- West Valley	Happy Creek Minerals Ltd.	Cu, Mo, Au, Ag Re; L04:Porphyry Cu±Mo±Au; 092ISE199	na	Mapping, rock sampling, 3-D IP, aerial photography.
Shovelnose	Westhaven Ventures Inc.	Au; H05:Epithermal Au-Ag-Cu low sulphidation; 092HNE309, 308	na	Approx. 20,000 m in 50 holes. Third vein zone intersected in South zone. New targets identified in regional prospecting, ground magnetic, soil, and resistivity surveys.
Spences Bridge	Talisker Resources Ltd.	Au, Ag; H05:Epithermal Au-Ag-Cu low sulphidation; 092O 054, 60, 143, 092INW092, 110, 092ISW118, 124, 84	na	Regional stream-sediment survey, prospecting.
Spius	Pacific Ridge Exploration Ltd.	Cu, Mo; L04:Porphyry Cu±Mo±Au; 092HNW027	na	Diamond drilling 1087 m in 4 holes.
Treasure Mountain	Nicola Mining Inc.	Ag, Pb, Zn; I05:Polymetallic veins; 092HSW066, 117, 48, 116, 092HSE240, 136, 261, 75	I: 33,000 t 828 g/t Ag, 3.80% Zn, 4.16% Pb Inf: 120,000 t 925.6 g/t Ag, 4.36% Zn, 2.79% Pb	Soil sampling.
Treasure Mountain Silver	New Destiny Mining Corp.	Ag, Au, Cu, Zn; I05:Polymetallic veins Ag- Pb-Zn±Au, L04:porphyry?; 092HSW066, 117, 092HSE240	na	Trenching, access, diamond drilling (4 holes, 102 m)

M = Measured; I = Indicated; Inf = Inferred

four target areas. Drill results included 6.18 g/t Au, 0.80% Cu and 2.63 g/t Ag across an interval of 4.55 m.

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).

7.1.3. 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 (Fig. 3).



Fig. 3. Mineral tenure ownership covering the Spences Bridge Group.

Talisker is prospecting for epithermal mineralization (Fig. 4) and conducting regional stream-sediment sampling to identify targets. They have also been working on a nearby property covering a target area they call the Remington Belt north of the Bridge River camp in Bridge River complex and Taylor Creek Group rocks. They recently acquired Bralorne Gold Mines Ltd. (see above).



Fig. 4. Epithermal textures (crustiform quartz, chalcedony veining) in hand specimens collected in Talisker Resources Ltd.'s regional exploration of the Spences Bridge belt.

7.1.4. Elk (Bayshore Minerals Inc.)

Bayshore acquired the **Elk** gold project in May. Initial work included a site-wide airborne magnetic and gamma-ray spectrometric survey. They also completed a lidar survey over workings, and baseline environmental monitoring to update existing hydrology, hydrogeology, water quality, and ecological data. Bayshore is currently a private company. **Elk** produced about 51,500 oz of gold between 1992 and 1995 from 14,730 t of ore, mainly from an open pit. Bulk sampling resumed in 2012-2014 when 7761 t with average grade 14.81 g/t 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.

7.1.5. 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. Initial work by Tempus consisted of soil geochemistry and beginning a Joint Ore Reserves Committee-compliant update of mineral resources to include 2010-2011 drilling. They propose additional drilling. Skeena Resources filed a Notice of Work before the sale. 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. Blackdome 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 have been compared to the Bralorne-Pioneer orogenic deposits.

7.1.6. Donna (Pinnacle North Gold Corp. 60%; Eagle Plains Resources Ltd. 40%)

Pinnacle North Gold Corp. optioned the **Donna** project from Eagle Plains Resources Ltd. and drilled one hole. Targets include epithermal and intrusion-related gold veins. Au-Ag-Pb-Zn skarn mineralization is also known. Previous drilling intersected 2.0 m of 8.9 g/t Au. Recent work included an airborne magnetic survey and soil geochemistry. A multi-year permit allows for additional drilling.

7.1.7. Pellaire (Blue Lagoon Resources Inc.)

Recently-listed Blue Lagoon Resources Inc. started work at the Pellaire property with soil and rock sampling and a ground magnetic survey. Anomalous results at the John Henry prospect led them to propose follow up and restoration of damaged access. Pellaire was bulk sampled in the 1990s. Quartz veins with gold, silver, and bismuth telluride were the target.

7.1.8. Princeton Gold (Canarc Resource Corp. 75%; Universal Copper Ltd. 25%)

Late in 2018 Canarc optioned the **Princeton Gold** property and completed a 2350 line-km aeromagnetic survey. Subsequent work included interpretation of the aeromagnetic results, mapping, sampling, and 500 m of trenching. Targets are gold-bearing quartz veins.

7.1.9. Merit (Independence Gold Corp.)

Independence Gold Corp. identified seven gold targets at the **Merit** property in the Spences Bridge belt, based on surface rock samples. A sample from Sullivan Ridge graded 9.5 g/t Au and 341 g/t Ag. They also commissioned a ground magnetic survey over the property. Early-stage metallurgical testing yielded gold recoveries of 99.5% and 96.6% using gravity, flotation, and cyanide leach.

7.1.10. Nicoamen (Independence Gold Corp.)

Independence reported initial results from the **Nicoamen** property, also in the Spences Bridge belt, including surface samples grading 3.91 and 4.56 g/t Au. They mapped the property and completed a ground based magnetic survey.

7.1.11. Black Duck (Karam Minerals Inc.)

Karam Minerals reported a till survey, soil survey, hand trenching, and prospecting at the **Black Duck**, a property acquired by staking in 2018. The work follows mapping, magnetic, and geochemical surveys in 2018. Targets are gold-bearing quartz veins similar to the Vidette epithermal past-gold producer to the west.

7.1.12. Treasure Mountain (Nicola Mining Inc.)

At the **Treasure Mountain** property, Nicola Mining started a soil geochemistry survey, to be completed in 2020. The silver 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.

7.2. Selected porphyry projects

More than 12 exploration projects focussed on porphyry deposits in 2019. Continuing work at Copper Mountain Mining Corporation's **New Ingerbelle**, and near-pit drilling at **Copper Mountain** have added years to mining operations (see section 3.1.2.). Exploration at New Gold Inc.'s **New Afton** may also add to reserves.

7.2.1. Big Kidd (Jiulian Resources Inc.)

Jiulian drilled more than 4191 m in 9 holes at the **Big Kidd** project in the Aspen Grove camp. Step-out holes targeting the Bigg Kidd breccia zone encountered porphyry-style alteration and low-grade copper-gold mineralization. One hole intersected a second zone of mineralization and alteration at depth, including potassic alteration. The hole terminated due to drilling difficulty. Another deep hole is under consideration. The **Big Kidd** project is targeting Late Triassic alkalic porphyry Cu-Au mineralization.

7.2.2. MPD (Dunnedin Ventures Inc.)

Dunnedin carried out 1766 m of drilling in 3 holes, mapping, prospecting, and sampling at their **MPD** Porphyry project. MPD is a consolidation of the Man, Prime, and Dillard alkalic porphyry Cu-Au targets. Significant surface results include 0.89% Cu across 46 m in a trench sample at the Man area, and grab sample results of 0.80% Cu with 0.32 g/t Au at Dillard, 2 m of 0.49% Cu with 0.26 g/t Au and a grab sample grading 1.03 g/t Au with 9.40 g/t Ag at Prime.

7.2.3. Spius (Pacific Ridge Exploration Ltd.)

Pacific Ridge drilled 1087 m in 4 holes at **Spius**, encountering low-grade copper-molybdenum mineralization and porphyry style mineralization. They note the highest grades at the bottoms of two holes and in the north of their target area.

7.2.4. Amarillo (Troubadour Resources Inc.)

Troubadour drilled 1075 m in four holes. Three targeted a coincident geochemical, IP and magnetic anomaly and the fourth a chargeability high. Before drilling they carried out mapping, prospecting, and sampling. **Amarillo** is about 10 km south of the **Brenda** past-producing Cu-Mo porphyry. Like **Brenda**, the target is calk-alkaline porphyry mineralization related to the underlying Pennask batholith.

7.2.5. Rateria-West Valley (Happy Creek Minerals Ltd.)

Happy Creek Minerals Ltd. carried out 3D IP surveys over two newly identified target areas, the PIM and Abbott prospects, on the West Valley part of the **Rateria-West Valley** property. The geophysics followed geological mapping, prospecting, and high-resolution aerial photography. Initial surface grab samples returned 5 m of 0.41% Cu and 10 m of 0.29% Cu with trace Mo. Samples at Abbott returned 0.21 and 0.51% Cu. The **Rateria**- **West Valley** property is in the Guichon batholith south of the Highland Valley Copper mine.

7.2.6. Treasure Mountain Silver (New Destiny Mining Corp.)

New Destiny Mining Corp. drilled and trenched at the **Treasure Mountain Silver** project. The first holes were to test a porphyry copper-gold target (Superior), the site of recent trenching and historical trenches and adits. The property partially surrounds the Treasure Mountain silver mine.

7.2.7. Perk-Rocky (Ethos Gold Corp.)

Ethos optioned and conducted a mapping program at the grass roots stage **Perk-Rocky**, including 89 rock samples, 500 talus samples, and 39 stream-sediment samples. The work revealed numerous occurrences of chalcopyrite+/-bornite+/-Cu oxide and propylitic alteration. They also flew a 657 line-km VTEM and magnetic survey.

7.2.8. Worldstock (Pacific Empire Minerals Corp.)

Pacific Empire Minerals conducted a preliminary soil survey at their recently optioned **Worldstock** project. The company has submitted a Notice of Work for drilling. **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.

7.2.9. Mackenzie Copper (Carube Copper Corp.)

Carube Copper completed mapping and sampling at **Mackenzie Copper**, following porphyry style mineralization in the Hurley River pluton, part of the Scuzzy plutonic suite at the northeastern margin of the Coast Plutonic Complex.

7.2.10. Miner Mountain (Sego Resources Inc.)

At **Miner Mountain**, Sego Resources identified new targets through data compilation and reviewing existing drill core. Trench sampling returned 18 m grading 0.96% Cu and 0.31 g/t Au early in the year. Multiple targets at Miner Mountain are alkalic copper-gold type. Sego reported targets at the Cuba, Empress, South and Sovereign zones for potential drilling in 2020. They have a multi-year permit for drilling and trenching.

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) and other Paleozoic strata. Although a few were active in 2019, most projects focused on polymetallic vein targets.

7.3.1. BC Cobalt (Blackstone Minerals Limited)

Blackstone conducted mapping, stream-sediment, and soil sampling at its **BC Cobalt** project, formerly called the Little Gem. Targets are cobalt-gold bearing veins, and copper-gold veins in the northwestern Bridge River camp. Blackstone

sees similarities in geological setting to the Bou-Azzer cobalt district of Morocco where economic cobalt mineralization is found near a contact between serpentinite and quartz diorite. Mineralization at **BC Cobalt** is near the contact between the Bralorne-East Liza complex (Permian) and a Late Cretaceous granodioritic intrusion of the Coast Plutonic Complex.

7.3.2. Hedge Hog (Surge Exploration Inc. 60%; Eastfield Resources Ltd. 40%)

Surge Exploration Inc. trenched at the **Hedge Hog** project, following up soil geochemistry anomalies from a 2018 survey. The primary target is VMS mineralization, the presence of which is suggested by sulphide boulders discovered in the 1990s. Of 29 excavations, 25 reached bedrock. Surge Exploration announced in December they would be dropping the option for 60% interest.

7.3.3. Fairview (Gold Lion Resources Inc.)

Gold Lion flew a 466 line-km airborne magnetic survey over its **Fairview** property, acquired in 2018 by staking. They also reported rock samples anomalous in Cu (1.48%, 1.24%) and Zn (1.78%). Polymetallic vein mineralization is known at several locations on the property.

7.3.4. North Brenda (Bitterroot Resources Ltd.)

Bitterroot conducted IP and gravity surveys on its **North Brenda** property. They have identified six areas of potential carbonate replacement-type mineralization at the Summit zone, where they propose drilling.

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. New Craigmont (Nicola Mining)

Nicola Mining announced results of 2018 drilling on both historically mined material piled in waste terraces and in the Craigmont Central zone early in the year. They carried out additional drilling to test the Central zone in 2019. Highlights from the No. 3 mineralized body include 84.00 m 0.34% Cu, 44 m 0.45% Cu, and 13 m 0.65% Cu with magnetite. Other work included soil geochemistry, mapping, analysis of historic core, and multispectral mapping. They are also developing a resource estimate for the Craigmont mine waste terraces. The material was tested using X-ray transmission sorting technology. In five out of eight tests, grades were increased to greater than 1% Cu with up to 50% Fe. They are also carried out flotation tests.

The Merritt Mill is at the Craigmont mine site. It has undergone about \$3 million in recent modifications but is not yet recommissioned. 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.

7.4.2. Fox Tungsten (Happy Creek Minerals Ltd.)

Happy Creek Minerals drilled 372.5 m in two holes near the Nightcrawler zone at its **Fox Tungsten** project. Fox is a tungsten skarn project with an existing resource of 582,400 t 0.826% WO₃ (Indicated) and 565,400 t 1.231% WO₃ (Inferred) at Ridley Creek and BN zones. The two holes were drilled 400 m apart at the Nightcrawler zone, south of the existing resource area. Results included 6.3 m 0.43% WO₃ in one hole and 4.0 m 0.29% WO₃ in the other.

7.5. Selected mafic and ultramafic hosted projects

Recent interest in cobalt and platinum-group metals has stimulated exploration on several properties.

7.5.1. Olivine Mountain (GSP Resources Corp.)

GSP Resources had a seven-hole 1200 m November drill program at its **Olivine Mountain** project in the Tulameen complex. Grab sampling returned encouraging Cu, Au, and Pd values from target areas and initial drilling intersected visible sulphide. Drilling follows mapping, soil geochemistry, and an airborne VLF-EM survey in 2018. The Tulameen complex is an Alaskan-type Late Triassic mafic-ultramafic intrusion.

7.5.2. Iron Lake (GK Resources Ltd. 60%; Eastfield Resources Ltd. 40%)

Eastfield reported an IP survey at **Iron Lake**. GK Resources is an optionee. The property covers a multiphase maficultramafic intrusion that hosts disseminated sulphide coppergold mineralization with anomalous platinum and palladium, and massive sulphide mineralization with copper, nickel, and cobalt values. Gold values in rock and soil are reported in Nicola Group rocks east of the intrusion.

7.6. Selected specialty metals and industrial mineral projects

Exploration for industrial minerals often goes unreported. Probably the most common type of exploration is bulk sampling for test marketing purposes. A few industrial minerals explorers have reported their work.

7.6.1. Mont (Leo Lindinger)

Following test pits in 2018, Leo Lindinger drilled the **Mont** property, a bentonite prospect in an accessible area. All 3 holes intersected bentonite clay (Fig. 5). Results so far suggest this is a large deposit. Historically the area has been explored mainly for gold, copper, zinc, and silver in epithermal, hot spring or porphyry and transitional vein environments. Recognition of a potentially economic bentonite deposit is recent.

7.6.2. Juniper Creek (ZMM Canada Minerals Corp.)

ZMM is permitted to bulk sample zeolite at its Juniper



Fig. 5. Bentonite clay in drill core at the Mont bentonite prospect. Photo courtesy of L. Lindinger.

Creek project for test marketing. Several species are present, including analcime, chabazite, clinoptilolite, phillipsite, levyne-Ca. The company also have Notices of Work in process for two other locations.

8. Geological research

Plouffe and Ferbey (2019) published an indicator mineral study for the Gibraltar and Woodjam deposits, examining middensity and heavy bedrock sample concentrates for minerals that have the potential to be used as porphyry copper indicator minerals. Shewchuk et al. (2020) examined major oxides and pathfinder elements in subglacial till near the Guichon Creek batholith for potential use as exploration tools. Norris and Fortin (2019) have taken an initial step toward digitizing geochemical data submitted for assessment. They assembled a digital database, taking geochemical data from soil, silt, stream-sediment, and till analyses on more than 34,000 samples included in 120 assessment reports from the Interior Plateau. Schiarizza (2019) summarized stratigraphic studies focussed on the Nicola Group between Quesnel and Kamloops and Schiarizza et al (2020) report new U-Pb zircon detrital ages from the Gun Lake unit in the Bridge River area.

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Exploration and mining in the Southeast Region, British Columbia

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1. Introduction

The Southeast Region (Fig. 1) offers a variety of mining and exploration opportunities accessible by well-developed infrastructure. Five metallurgical coal mines that operated in the Elk Valley in 2019 account for most of Canada's coal production and exports. Several industrial mineral mines produce silica, magnesite, and gypsum. Limestone, smelter slag, rock wool, aggregate, rip rap, railroad ballast, flagstone, dimension stone, sand and gravel are quarried, and placer mining occurs throughout the region. The region hosts many historic producers dating back to the mid-1800s, including the lead-zinc-silver Sullivan Mine, and many small producers from the Rossland, Greenwood, Sheep Creek, and Slocan gold and silver camps. Exploration for base metals and precious metals continues to be a focus. The Trail smelter (Teck Resources Ltd.) is still in operation, and produces approximately 305,000 t of refined zinc, 90,000 t of refined lead, and 16 to 18 Moz of silver annually.

Exploration slowed in 2019 relative to 2018. Drilling continued at some projects that have been active in the last several years and started at a few new projects. Mine expansion and exploration continued at the coal mines in the Elk Valley and grassroots exploration took place on several projects, and for assessment work.

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 Petroleum Resources, the Association for Mineral Exploration in British Columbia, and EY LLP. For the Southeast Region, exploration expenditures were estimated at \$45.0 million and exploration drilling was estimated at approximately 117,700 m (Clarke et al., 2020; EY LLP, 2020).

2. Geological overview

The Canadian Cordillera has long been of interest to the exploration industry. It is a collage of allochthonous terranes, parathochtonous terranes, and authochthonous basement, containing diverse rocks and structures. Metallogenetic processes generated the varied deposit types that contribute to the mineral endowment of British Columbia (Nelson et al., 2013).

The Southeast Region (Fig. 1) contains elements of ancestral North America (Laurentia) including: Archean to Mesoproterozoic basement rocks; Proterozoic rift and intracratonic basin successions (Belt-Purcell and Windermere supergroups); Paleozoic to Jurassic passive-margin, shelf, and slope carbonate and siliciclastic successions that were deposited on the western flank of the ancient continent (Kootenay terrane, and North American platform); and Jurassic to Cretaceous foreland basin deposits. It also contains parts of the Slide Mountain terrane, which records mid- to late- Paleozoic backarc extension that split the western flank of ancestral North America to form the Slide Mountain ocean, and Quesnel terrane (Quesnellia) and its basement (Okanagan subterrane; Nelson and Colpron, 2007; Nelson et al., 2013). Magmatic intrusive rocks such as those formed in the Proterozoic (Movie intrusions) and Devonian (diatremes and volcanic rocks) represent periods of extension along the margin of ancestral North America, whereas others (Jurassic and Cretaceous) are related to subduction and crustal thickening. Cenozoic magmatic rocks and exhumation of the normal fault-bounded metamorphic complexes occurred during post-orogenic Tertiary extension.

Historically, the Canadian Cordillera has been divided into five northwest-trending physiographic belts. The Southeast region includes two of these belts: the Rocky Mountain foreland belt, which consists mainly of unmetamorphosed sedimentary successions that were thrust northeastward in thin-skinned sheets; and the Omineca belt, which includes more deformed and higher grade (greenschist to amphibolite) siliciclastic and volcanic rocks, and basement-cored gneiss domes (Monger, 1999). For further details about the geology of the Southeast Region see Katay (2017).

3. Mines and quarries

The Southeast Region produces metallurgical coal from four mines in the Elk Valley, and continues to be an important source



Fig. 1. Mines and selected exploration projects, Southeast Region, 2019.

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of industrial minerals such as gypsum, magnesite, silica sand, mineral wool, dolomite, limestone, flagstone, railroad ballast, rip rap, smelter slag, and aggregate (Fig. 1).

3.1. Metal mines

In 2019, no metal mines operated in the Southeast Region.

3.2. Coal mines

The main coal deposits in southeastern British Columbia extend for 175 km following the northwest-southeast trend of the Rocky Mountain Front Ranges, and coal is produced from structurally thickened seams of the Mist Mountain Formation (Kootenay Group; Jurassic; Table 1; Figs. 1, 2). Today, four open pit mines are operated by Teck Coal Limited in the Elk Valley (**Fording River, Greenhills, Line Creek,** and **Elkview**). A fifth mine (**Coal Mountain**) reached the end of its reserves life and produced intermittently until Q2 of 2019. The pit operations are now suspended, though the plant and load out facilities continued to process coal into Q3.

With a history that dates to the 1800s, several underground coal mines operated in the region by the early 1900s. Openpit mining began in 1968, with the introduction of large-scale equipment, hydraulic shovels, and bulk mining methods. In 2004, the five Elk Valley mines consolidated into the Elk Valley Partnership and, in 2008, Teck Coal Limited acquired most of this partnership and began operating the open-pit mines. The main product is metallurgical coal (85%), with some thermal and pulverized coal injection (PCI) coal (15% combined). In 2019, total annual production from the mines in the southeast region was approximately 25.5 Mt of clean metallurgical coal.

In recent years, all mining in the Elk Valley watershed has been subject to conditions laid out in the trans-border Elk Valley Water Quality Plan (the Plan), which addresses the management of substances released by mining activities in the Elk Valley. It includes water diversion and treatment on mine sites, and establishes water quality targets for selenium, nitrate, sulphate, cadmium, and calcite in the Elk Valley watershed and flowing into the Libby reservoir system, downstream in Montana. All producing and proposed mine projects are engaged in research to improve technologies for active water treatment facilities and develop alternative and passive treatment methods.

Since its approval, the water quality objectives in the Plan have undergone criticism, and continue to be the focus of ongoing discussions between provincial, federal, and transborder working groups. Draft changes to the objectives are expected to be announced early next year and may affect the current targets and limits of the Elk Valley Water Quality plan.

Under the current plan, Teck Coal Limited has committed to constructing five active water treatment facilities. The first facility has operated at the **Line Creek** mine since February 2016, and a second treatment step was successfully added in 2018. Construction on the facility at **Fording River** began in 2019, with the design modifications used at the **Line Creek** facility. At least four more facilities may be needed to meet water quality objectives. Passive water treatment trials have also been underway to reduce the reliance on, and increase the effectiveness of, active water treatment. The first saturated rock fill pilot project was constructed at Elkview in 2018. It uses biological processes enhanced by the addition of nutrients (methanol and phosphoric acid) to remove nitrate and selenium from the water. This technique is reported to almost completely remove nitrate and selenium from water at processing rates of 10 million litres per day. In 2019, Teck received approvals to expand this project (Teck, 2019). Capital costs of a saturated rock fill facility are approximately 20% of those of an active water treatment facility, and annual operating costs are approximately 50%. Total capital spending by Teck Coal Limited on water treatment in 2019 was estimated at approximately \$235 million, making efficiencies in treatment techniques an attractive option. Other water quality trials are underway, including capping and reclamation techniques and methods for calcite management (Teck, 2019). Jameson Resources Ltd. (Crown Mountain) and North Coal Ltd. (Michel Coal) are also actively involved in independent design and test work for their proposed mine projects.

3.2.1. Fording River (Teck Coal Limited)

The **Fording River** mine (Fig. 2) consists of approximately 23,000 ha of coal lands, and produces primarily metallurgical coal, and a small amount of thermal coal. The current annual production capacity of the mine is 9 Mt; the preparation plant has a capacity of 9.5 Mt of clean coal. In 2019, production at **Fording River** (Fig. 3) was mainly from their Eagle Mountain, **Swift**, and Lake areas. Exploration drilling and large diameter core drilling (103 RC holes, 33,059 m; 15 LDC holes, 2510 m) to test seam extensions and coal quality, occurred in their producing pits and their Castle Mountain area. The company also conducted geotechnical drilling and environmental baseline work in their producing pits and extension areas.

West of the current mine area at **Fording River**, the **Swift** expansion area comprises both previously mined (last in the 1990s) and unmined zones. With a planned 25-year mine life, the expansion project will use the existing Fording mine facilities, and is expected to produce 175 Mt of clean coal. Pilot testing and construction began in 2018 on a selenium water treatment facility at **Fording**, in tandem with continued design modifications and test work at the first facility at **Line Creek**. Future expansions would include highwall pushback at the Turnbull and Henretta pits and expansion at their Castle Mountain and Greenhills Ridge areas. Proven and Probable reserves at the mine are from the Eagle Mountain, Swift, Turnbull, and Castle Mountain areas, and are projected to support a further 43 years at planned production rates.

3.2.2. Greenhills (Teck Coal Limited 80%; POSCO Canada Limited ('POSCAN') 20%)

The **Greenhills** mine produces mainly metallurgical coal and lesser thermal coal, and consists of approximately 11,800 ha of coal lands. The mine is on the west limb of the Greenhills syncline (Fig. 2). Coal seams generally grade in rank from



Fig. 2. Map of the Kootenay Group and East Kootenay coalfields, including the major coal mines and selected projects in southeastern British Columbia. From British Columbia Geological Survey (2020).

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Mine	Operator; Partner	Commodity	Forecast 2019 Production (based on Q1- Q3)	Reserves (as of December 31, 2018)	Resource (as of December 31, 2018)	Comments
Fording River	Teck Coal Limited (100%)	HCC	2019: 8.15 Mt clean	HCC P: 166.4 Mt Pr: 221.5 Mt	HCC M: 407.6 Mt I: 925.5 Mt Inf: 775.6 Mt	EA approval of Swift expansion (2015); exploration drilling in active pits and expansion areas; coal quality testing; geophysical work and exploration in future expansion areas; pilot water treatment construction; P+Pr reserves are projected to support a further 43 years of mining at current production rate.
Greenhills	Teck Coal Limited (80%); POSCAN (20%)	HCC	2019: 6.1 Mt clean	HCC P: 9.7 Mt Pr: 155.3 Mt	HCC M: 162.2 Mt I: 247.2 Mt Inf: 177.1 Mt	Cougar Pit Expansion (CPX) approved (2016); exploration drilling in expansion areas; coal quality testing; P+Pr reserves are projected to support another 28 years of mining at current planned production rates.
Line Creek	Teck Coal Limited (100%)	HCC, TC	2019: 3.95 Mt clean	HCC P: 2.4 Mt Pr: 57.8 Mt TC P: 0.4 Mt Pr: 10.1 Mt	HCC M: 312.2 Mt I: 406.5 Mt Inf: 372.8 Mt TC M: 1.7 Mt I: 1.9 Mt Inf: 1.8 Mt	Burnt Ridge Extension (BRX) approved (2016); pre-stripping on Mount Michael (LCO2); exploration drilling and coal quality test work in expansion areas; Additional of treatment process to West Line Creek water treatment facility, with further design optimization underway; P+Pr reserves at Line Creek are projected to support another 18 years of mining at planned production rates.
Elkview	Teck Coal Limited (95%); Nippon Steel Corporation (2.5%), POSCO (2.5%)	НСС	2019: 7.1 Mt clean	HCC P: 6.8 Mt Pr: 258.3 Mt	HCC M: 223.0 Mt I: 156.7 Mt Inf: 205.6 Mt	Baldy Ridge Extension (BRE) approved (2016); exploration drilling in active pits and expansion areas; coal quality testwork; P+Pr reserves expected to support approximately 38 more years at current production rate.
Coal Mountain	Teck Coal Limited (100%)	PCI	2019: 0.2 Mt clean	na	PCI M: 56.8 Mt I: 22.9 Mt Inf: 4.8 Mt	Mineable reserves at CMO depleted in Q3 2018; reclamation begun; facilities also processed coal trucked from Elkview mine; facilities to be placed on care and maintenance; Coal Mountain Phase II (CMO2, Marten Wheeler) would use facilities from CMO, but project currently remains on hold.

Table 1. Coal mines, Southeast Region.

HCC = hard coking coal; PCI = pulverized coal injection; TC = thermal coal; P = Proven; Pr = Probable; M = Measured; I = Indicated; Inf = Inferred



Fig. 3. Truck and shovel operations at Fording River mine.

medium-volatile bituminous in the lower parts of the section, to high-volatile-A bituminous at higher intervals, with a small amount of thermal coal also produced. Currently, the annual production capacity of clean coal is 5.9 Mt from the mine and 5.4 Mt from the preparation plant. Production is mainly from the Cougar pit area; Proven and Probable reserves are projected to support another 28 years of mining at planned production rates.

The **Cougar Pit Extension (CPX)** project (Fig. 2) is the expansion area for Greenhills Operations. Approved in 2016, it lies immediately north of the existing operations, and at full development, will merge with the Fording River **Swift** expansion. Exploration drilling in 2019 (8 RC holes, 2401 m; 16 LDC holes, 844 m) included both in-pit drilling to update structural and seam quality models, and further step-out drilling in their permitted extension areas for the next phases of mining. Additional geotechnical drilling was conducted, and environmental baseline work continued.

3.2.3. Line Creek (Teck Coal Limited)

The **Line Creek** mine (Fig. 2) consists of approximately 8200 ha of coal lands and produces mainly metallurgical coal and small amounts of thermal coal. Coal seams are predominantly medium-volatile bituminous in rank, with some high volatile-A bituminous coals near the top of the section. The current annual production capacity of the mine and preparation plant is approximately 4.0 Mt of clean coal.

In 2019, production was mainly from the Burnt Ridge extension (BRX), Mount Michael (MTM), and Mine Services extension (MSX) pits. Further exploration and coal quality testing were done in 2019 to prepare for the next phases of mining. Exploration drilling (59 RC holes, 12,239 m; 9 LDC holes, 744 m) occurred in producing pits and on their Burnt Ridge North extension area to update geological models and for coal quality test work. Additional drilling was completed for geotechnical assessments, and environmental baseline

studies are ongoing. Proven and Probable reserves at Line Creek are projected to support planned production rates for a further 18 years.

The West Line Creek water treatment facility was commissioned in February 2016, with additional design changes in 2018.

3.2.4. Elkview (Teck Coal Limited 95%; Nippon Steel Corporation 2.5%; POSCO Canada Limited 2.5%)

The **Elkview** mine (Fig. 2) produces mainly high-quality mid-volatile hard coking coal from thrust repeats of mineable seams in a southwest-plunging syncline. The mine site consists of approximately 27,100 ha of coal lands. The current annual production capacity of the mine and preparation plant is approximately 7.0 Mt of clean coal. Teck estimates a remaining reserve life of approximately 38 years at the current production rate. In 2019, drilling continued in their active pits and expansion areas (32 RC holes, 7348 m; LDC holes, 1200 m), and production was primarily from the Baldy Ridge, Natal Ridge, Adit Ridge expansion areas.

In 2019, **Elkview** received approval to expand their saturated rock fill project after successful trials. The project uses biological processes to sequester selenium and other substances and will be used as another step in the water treatment process at Teck's mine sites in the Elk Valley.

3.2.5. Coal Mountain (Teck Coal Limited)

Coal Mountain (Fig. 2) consists of approximately 3000 ha of coal lands, and produces mainly PCI (metallurgical) and thermal coal. Opened around 1905 as the Corbin mine, coal was mined underground intermittently until 1935. The historic underground workings at the mine posed challenges to mining operations and, in 2018, the mine neared the end of its reserves life. The mine produced a small amount in the first half of 2019.

The plant and load out facilities at **Coal Mountain** continued to process coal until Q3 2019, including a small amount of coal that was trucked from the **Elkview** mine. Reclamation of the mine is well underway on the final lifts of the dry stacked tailings facility, and waste dump spoils. The wash plant (with an annual capacity of approximately 3.5 Mt) and load out facilities will be kept operational, but on care and maintenance. Teck Coal Limited plans to maintain production levels by optimizing and expanding production at their other metallurgical coal mines, and from recently approved expansion areas.

3.3. Industrial mineral mines and quarries

The Southeast Region hosts several industrial mineral mines, the largest of which are in the Rocky Mountain foreland belt, where upturned strata are exposed and easily mined (Fig. 1). A variety of smaller mines and quarries exist throughout the region (Table 2).

3.3.1. Mount Brussilof (Baymag Inc.)

Baymag Inc. produces high-quality magnesite year-round from their open-pit mine at **Mount Brussilof**. The deposit is

Mine	Operator	Commodity; deposit type; MINFILE	Forecast 2018 Production (based on Q1-Q3)	Reserves	Resource	Comments
Mount Brussilof	Baymag Inc.	Magnesite; hydrothermal sparry magnesite; 082JNW001	230,000 t	P: 50 Mt	na	MgO, and MgOH; sediment-hosted sparry magnesite.
Moberly Silica	HCA Mountain Minerals Limited (Northern Silica Corporation)	Silica; Industrial use silica, frac sand; 082N 001	na	20 to 140 mesh frac sand (dry) P: 8.9 Mt of 64% frac sand + Pr: 4.6 Mt of 64% frac sand (2014)	M + I: 30 to 140 mesh frac sand (dry): 37.5Mt at 70% frac sand + 11.3 Mt silica as frac sand residues (2016)	Drilling (7 DDH, 1900 m); mapping, sampling, thin section work; design modifications to processing plant.
Elkhorn	CertainTeed Gypsum Canada Inc.	Gypsum, anhydrite; Evaporitic bedded gypsum; 082JSW021	Gypsum: 300,000 t; Anhydrite: 120,000 t	na	na	Mine expected to remain open until 2023; the company will replace production by developing the Kootenay West mine (EAO certificate granted in 2018).
Winner	Rockwool Inc.	Gabbro/ basalt; Crushed rock for mineral wool; 082ESE265	Quarrying feed stock for mineral wool plant	na	na	Crushing, screening, stockpiling; environmental monitoring.

Table 2. Selected industrial mineral mines, Southeast Region.

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

in Cambrian carbonate rocks of the Cathedral Formation. The deposit is considered to have been produced by magnesium hydrothermal alteration and displays characteristics similar to Mississippi Valley-type mineralization (Paradis and Simandl, 2017). Several phases of magnesite (and minor pyrite) suggest episodic flow of hydrothermal fluids. Sulphides are removed as impurities from the product. Magnesite ore is transported by truck to the company's processing facilities in Exshaw Alberta for production of magnesium oxide (MgO) and magnesium hydroxide (MgOH). Annual magnesite production is approximately 230 kt.

3.3.2. Moberly Silica (HCA Mountain Minerals Limited)

HCA Mountain Minerals Limited (Northern Silica Corporation) continued work on their **Moberly Silica** project. The deposit has been mined since the early 1980s for silica sand, glass making, and other industrial uses. The silica deposit is in regionally extensive orthoquartzites of the Mount Wilson Formation (Middle to Upper Ordovician). At Moberly Mountain, the formation is ~ 99% SiO₂, partially de-cemented,

and friable along a fault zone. At the mine, the unit is nearly vertical, about 300 m thick, and extends along strike for 800 m. Sand grains in the orthoquartzite are well rounded, making it a suitable product for the frac sand industry. Redevelopment of the current operation and processing plant (300,000 tpy) began in 2015. In 2019, the company drilled (7 DD holes, 1900 m) to further test homogeneity along strike, and better characterize stratigraphy. Thin section work is being conducted to try to determine the controls on the selective dissolution of primary cements. The company also continued to work on design modifications at their plant to improve separation of different size fractions and products.

3.3.3. Elkhorn (CertainTeed Gypsum Canada Inc.)

Gypsum is produced near the western edge of the Rocky Mountains, east of Windermere. Gypsum-bearing, evaporitic strata of the Burnais Formation (Middle Devonian) were deposited in a restricted, shallow-marine embayment, and thrust upwards during the Mesozoic. Steeply dipping, mineable sections are 30 to 180 m thick. The **Elkhorn** mine produces approximately 320,000 tpy from three pits, and the mined gypsum is blended to meet quality standards for their products. The mine recently acquired a new market interest in a blended anhydrite product, and has begun marketing product that was once left behind as waste. This realignment will allow the mine to continue production until 2023. The company plans to replace gypsum production after mine closure with their new **Kootenay West** mine (see 5.1), which received conditional approval through environmental assessment in January 2018.

3.3.4. Winner (Rockwool Inc.)

Rockwool Inc. (formerly Roxul Inc.) operates two small seasonal quarries near Grand Forks, extracting gabbro from **Winner**, and basalt from **Friday** (North Fork). The material is trucked to the Rockwool Inc. manufacturing plant in Grand Forks, where it is blended with other mineral material to make mineral wool insulation, construction board, blankets, and pipe covering. The product is naturally fire-retardant.

4. Placer operations

Placer mines have operated in southeastern British Columbia since the gold rush began in 1864. Although activities were not tracked in 2019, 58 placer projects currently have active Mines Act permits that allow mechanized work, consisting of more than simple hand panning.

5. Mine development

In addition to the coal mine expansion projects that are currently in construction phases, one new gypsum mine, **Kootenay West** (CertainTeed Gypsum Canada Inc.), was granted an Environmental Assessment Certificate in 2018, with construction beginning in 2019 (Table 3).

5.1. Kootenay West (CertainTeed Gypsum Canada Inc.)

CertainTeed Gypsum Canada Inc. continued to advance the proposed Kootenay West project. The project was approved through the Environmental Assessment Office in January 2018 and has been working to fulfill conditions outlined in the approval. The quarry will have two pits, and mine gypsum from a deformed hydrated evaporite layer 20-25 m thick with beds of 75-95% gypsum in the Burnais Formation. The mine is expected to produce 16.9 Mt of gypsum at an average blended quality of 83.2%, and 400,000 tpy at full production rate. The current projected mine life is 43 years. Gypsum would be drilled, blasted, and crushed, then transported by truck to Exshaw, Alberta or Washington State, or by rail to Vancouver. In 2016 through 2019, the company focussed on environmental work and modifications to the mine design. Phase 1 construction, with estimated capital costs of \$20 million, also began in 2019. The mine will replace production after the Elkhorn mine is depleted.

6. Proposed mines and quarries

The Southeast Region has three proposed coal mines (Table 4): Michel Coal (North Coal Ltd.), Crown Mountain

(Jameson Resources Ltd.), and **Bingay Main** (Centermount Coal Ltd.). An industrial mineral mine, **Driftwood Creek** (MGX Minerals Inc.), is also proposed.

6.1. Proposed metal mines

There are currently no proposed metal mines in the region.

6.2. Proposed coal mines

The Southeast Region has several proposed coal mines in various phases of environmental assessment (Fig. 2). Each must demonstrate how they will meet the guidelines set out in the Elk Valley Water Quality Plan. Only **Michel Coal**, which includes **Loop Ridge**, **Tent Mountain**, and **Michel Head**, and **Crown Mountain** are described below.

6.2.1. Michel Coal (North Coal Ltd.)

North Coal Ltd., a wholly owned subsidiary of CoalMont Pty Ltd., entered the pre-application phase of environmental assessment for their **Michel Coal** project in 2015. With subsequent expanded resource delineation and coal quality test work, the company amended their project proposal to include not only **Loop Ridge**, but also their **Loop South, Tent Mountain,** and **Michel Head** areas (Fig. 2), and submitted a revised project description in September 2018. The expanded plan will give them more flexibility in blending product from different areas to specification for clients. The project is expected to produce between 2.3 and 4 Mt annually, with a 30-year mine life.

In 2019, work continued on their environmental baseline, permitting, and mine design. The project will use diversion, and active and passive techniques for managing waste rock and treating water to ensure that targets identified in the Elk Valley Water Quality Plan can be met. Drilling has identified 20 coal seams, between 5 and 20 m thick, and confirmed that coal is representative of typical Elk Valley hard coking coals (HCC). Structure and spacing of the seams gives the project a low (ca. 6:1) strip ratio. In 2018, the company released an updated resource estimate with 44.6 Mt Measured and 42.5 Mt Indicated (open-pit and underground) and is working towards an updated pre-feasibility engineering and design report.

6.2.2. Crown Mountain (NWP Coal Canada Limited 80%; Bathurst Resources Limited 20%)

The **Crown Mountain** property is along strike with **Line Creek** (Fig. 2), but separated by complex geology and thrust faulting. The property contains seven major Mist Mountain Formation coal seams, with combined average thicknesses of 15 to 35 m. In October 2014, the project advanced to the pre-application stage of environmental assessment and received application information requirements from the Environmental Assessment Office in April 2018. In 2019, Bathurst Resources Limited earned an additional 12% interest in the project, bringing their interest up to 20%. Bathurst could become a 50/50 joint venture partner after exercising all tranches in the terms of the agreement, with an investment totaling \$121.5M.
Project	Operator (partner)	Commodity; deposit type; MINFILE	Reserves	Resource	Comments
Kootenay West	CertainTeed Gypsum Canada Inc.	Gypsum; Evaporitic bedded gypsum, quarry; 082JSW005, 20	na	North and South quarries: Total 16.9 Mt (at average quality of 83-85%)	Granted a conditional EA certificate in January, 2018; environmental baseline work, permitting, and modifications to mine design; construction began in 2019; 400,000 tpy; 43-year mine life; blended product to market specifications.

 Table 3. Selected mine development projects, Southeast Region.

 Table 4. Selected proposed mines, Southeast Region.

Project	Operator (partner)	Commodity; deposit type; MINFILE	Reserves	Resource	Comments
Michel Coal	North Coal Ltd.	Coal (HCC and PCI); Open-pit and underground; 082GSE050	na	HCC M: 44.6 Mt I: 42.5 Mt; open-pit and underground (2015)	Entered pre-application of EA in 2015, re- submission of their project description in September (2018) to include all 3 mining areas; geotechnical studies and updates to mine design; coal quality testing indicates coal has similar characteristics to Elk Valley hard coking coal; drilling identified 20 coal seams with cumulative thickness of 70 m (14% of a 504 m section in the Mist Mountain Formation).
Crown Mountain	NWP Coal Canada Limited 80% (Bathurst Resources Limited 20%)	Coal (HCC and PCI); Open-pit; 082GNE018	HCC P: 42.60 Mt Pr: 4.91 Mt PCI P: 7.13 Mt Pr: 1.19 Mt (2014)	HCC + PCI M: 68.9 Mt I: 6.0 Mt (2014)	Option agreement with Bathurst Resources Limited, with ability to earn 50% with investment of \$121.5 M; Pre-application of EA (2014); Application Information Requirements (AIR) received in April (2018); coal quality test work; water quality and treatment studies involving passive biological treatment; engineering studies and mine design; bankable feasibility study; 16-year mine life; 1.7 M tpy.
Driftwood Creek	MGX Minerals Inc.	Magnesite; Hydrothermal sparry magnesite, quarry; 082KNE068	na	M + I: 7.847 Mt grading 43.27% MgO Inf: 55.8 Mt (2016; using cutoff grade of 42.5% MgO)	Preliminary Economic Assessment: 169,700 t of MgO, average grade of 43.27% MgO, 19-year mine life, 2.4:1 strip ratio; scoping study underway; environmental baseline studies; 100 t bulk sample; preliminary test work indicates recovery rates of 93.4% reverse flotation and removal of up to 70% silica and 30% calcium oxides; bulk of resource is within 100 m of surface; 2016 drilling extended the zone; 20-year mine lease acquired.
Black Crystal	Eagle Graphite Corp.	Graphite; Metamorphic rock-hosted flake graphite; 082FNW260, 283	na	Regolith + calc- silicate; M + I: 19.23 Mt at 1.35% fixed carbon; Inf: 23.92 Mt at 1.3% fixed carbon (2018)	Research and development; possible application for Li-ion batteries.

HCC = hard coking coal; PCI = pulverized coal injection; TC = thermal coal; P = Proven; Pr = Probable; M = Measured; I = Indicated; Inf = Inferred

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Results released in 2019 from coal quality test work indicate a premium hard coking coal in the north pit, and a low-volatile hard coking coal in the south pit. Coal quality test work indicates that approximately 84% of the coal is hard coking coal, the remainder PCI coal. Environmental baseline work and geotechnical drilling continued, as did engineering work on spoil pile design and water treatment, including the use of biological reduction of nitrate and selenium by naturally occurring microbes in waste piles. A feasibility study for the project is in progress and includes an open-pit mine with an estimated production capacity of 1.7 Mtpy of clean coal and a 16-year mine life. In 2014, the company completed a resource estimate of 74.9 Mt (Measured + Indicated).

6.3. Proposed industrial mineral mines

MGX Minerals Inc.'s **Driftwood Creek** project is a proposed magnesite mine. The **Black Crystal** graphite quarry (Eagle Graphite Corp.) is on care and maintenance while the company focusses on research and development for their product. Several small quarries and pits for dimension stone, flagstone, and sand and gravel are not considered here.

6.3.1. Driftwood Creek (MGX Minerals Inc.)

At the **Driftwood Creek** property, cliff-forming, steeply dipping beds of sparry magnesite are interlayered with dolostones and dolomitic limestones of the Mount Nelson Formation (Proterozoic). The deposit is 100 to 300 m wide, to a depth of approximately 110 m, and has been traced along strike for 2000 m. In 2018, the company released a preliminary economic assessment for a 1200 tpd quarry operation. The mine would produce 169,700 t of MgO at an average grade of 43.27% MgO, with a 19-year mine life, and 2.4:1 strip ratio. In 2019, the company continued environmental baseline studies and obtained permits for additional infill drilling.

6.3.2. Black Crystal (Eagle Graphite Corp.)

Eagle Graphite Corp. operates the Black Crystal flake graphite open-pit quarry on Hodder Creek and a processing plant 10 km west of Passmore. In the Kootenay terrane, the property is underlain by Paleozoic upper amphibolite-grade gneisses that were exhumed during Tertiary extension. Disseminated fine- to coarse-flake graphite is distributed along foliation in organic-rich calcsilicates and marbles, across an area of about 500 m^2 . At the quarry location, the graphitic horizon is 30-40m thick, immediately underlying overburden, and dips subparallel to topography. Graphite is in 2 zones: a 'hard rock' zone, and an overlying 'regolith' zone. The regolith zone is the near-surface weathered zone 2-4 m thick and has grades of up to 6.95% carbon. Most of the deposit is friable, and blasting is not required. Sand and aggregate are by-products during the mining and refining process. In 2019, the company continued research into processing techniques and received a \$290,000 grant from CleanBC toward advancing lithium-ion graphite.

7. Selected exploration activities and highlights

Exploration continued in the Southeast Region in 2019 for numerous targets, including base and precious metals, industrial minerals, and coal (Fig. 1; Table 5).

7.1. Selected precious metal projects

Dating back to the 1880s, exploration for precious metals is ongoing in the Southeast Region for vein (epithermal and mesothermal), porphyry-related, and skarn systems, and in the East Kootenays along the Kimberley Gold trend, where fault and vein structures, and Mesozoic intrusions are coincident with deeper basement structures (Höy, 1982; McMechan, 2012; Seabrook, 2015).

7.1.1. Gold Shear (PJX Resources Inc.)

PJX Resources Inc. continued work at their Gold Shear property in 2019. Steeply dipping north-northeast mineralized shear zones (pyrite, galena, chalcopyrite, sphalerite, and rare visible gold) on the property cut quartzites and siltstones of the middle Aldridge Formation (Mesoproterozoic; Purcell Supergroup), and trend SW-NE, parallel to the Perry Creek fault zone. The David zone, a gold-mineralized quartz vein, was discovered in 1990 (British Columbia MINFILE 082FSE108) and has since been traced along strike for 1600 m and 150 m downdip, along with several other splays and veins. Drilling on the property between 1990 and 1996 intersected 0.8 m that graded 196.69 g/t Au, associated with weak to moderately conductive sulphides. 2018 VLF ground geophysics done by PJX identified a large conductive target area down-dip of the David Gold Zone, below the depth of historical drilling. In 2019, the company drilled (9 DD holes, 750 m) to test this target.

7.1.2. Ore Hill (Apex Resources Inc.)

The **Ore Hill** property is in the historic Sheep Creek gold mining camp, where Late Jurassic gold mineralization (133 Ma; pyrite with lesser amounts of pyrrhotite, chalcopyrite, galena, sphalerite and rare visible gold) is found in steeply dipping quartz veins along northeast-trending structures. Between 1906 and 1940, a total of 3335 t of ore was mined and 115,671 grams of gold (34.7 g/t), 202,307 grams of silver (60.7 g/t), and 93,985 kilograms of lead and 88,639 kilograms of zinc were recovered (British Columbia MINFILE).

In 2017 and 2018, the property was under option to Margaux Resources Ltd. Margaux carried out mapping and sampling along a gold soil geochemical anomaly and identified gold mineralization in a 10 m wide breccia zone along a north-trending fault. The soil anomaly traced the fault for more than 1500 m across the Summit and Ore Hill claims, and rock sample results included 119 g/t and 105 g/t Au collected across an area 950 by 150 m. In 2019, Apex Resources Inc. compiled historic data, and identified two linear, north-trending magnetic anomalies from an airborne Heliogeotem survey that was flown in 2009. The western anomaly coincides with the soil and rock

Table 5.	Selected	exploration	projects,	Southeast	Region.
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Project	Operator (partner)	Commodity; Deposit type; MINFILE	Resource (NI 43-101 compliant unless indicated otherwise)	Comments
Bull River mine	Braveheart Resources Inc.	Cu-Ag-Pb-Zn+/-Au; Polymetallic veins; 082GNW 002, 6, 15	I: 1.51 Mt grading 1.91% Cu, 0.41 g/t Au, 15.6 g/t Ag at 1% CuEq cut-off Inf: 0.34 Mt grading 1.58% Cu, 0.36 g/t Au, 10.7 g/t Ag at 1% CuEq cut-off	Exploration drilling at Empire Strathcona (14 DD holes, 1389 m) and Rex (11 DD holes, 1697 m); Condemnation drilling on mine property for stockpiles (6 DD holes, 618 m); sampling and assay of the ore stock piles; mine planning; environmental baseline studies; updating mine plan and permitting.
Coal Creek	Crowsnest Pass Coal Mining Ltd.	Coal (HCC and PCI); underground; 082GSE035	HCC + PCI: 616 Mt in the upper 3 near- surface seams (2014)	Prefeasibility studies; geological modeling, baseline studies.
Duncan	Rokmaster Resources Ltd.	Zn-Pb-Ag; Carbonate-hosted; 082KSE023, 22	na	Mapping; sampling; soil geochemistry; historic drill core results include 7.5 m grading 6.2% Zn + 6.3% Pb, 4.8 m grading 11.4% Zn + 0.8% Pb, and 6.9 m grading 7.1% Zn + 4.6% Pb.
Elko	Pacific American Coal Limited	Coal (HCC, PCI); 082GSE029	M: 117.6 Mt I: 93.2 Mt Inf: 92.3 Mt (JORC 2019)	Drilling (8 RC, 1 large-diameter core; 3451 m); environmental baseline studies and permitting; mapping of five coal seams; 3 seams have hard coking coal quality, 2 seams have PCI coal.
Gibraltar	MGX Minerals Inc.	Si; Silica sandstone; 082JSW001	na	Drilling (5 DD holes, 200 m); metallurgical test work results indicated suitability for medium quality feedstock for metallurgical-grade silicon; sampled 97.8 to 99.9% SiO ₂ .
Gold Drop	GGX Gold Corp.	Au; Alkaline intrusion- associated Au; 082ESE055, 150, 152, 153, 285, 286, 287	na	Drilling (48 DD holes, 2284 m on C.O.D vein; 10 DD holes, 685 m on North C.O.D. vein); rock sampling; trenching; channel sampling; airborne magnetotelluric survey.
Gold Shear / David	PJX Resources Inc.	Au, Cu, Pb, Zn; Vein; 082FSE108	na	Drilling (9 DD holes, 750 m); drill targets identified from VLF survey to test down-dip extensions of the vein, below the level of historic working; historic chip sampling returned 0.4 m grading 144 g/t Au.
Kenville	Ximen Mining Corp.	Ag-Au-Cu+/-Pb, Zn, Cd, W; Au-veins, polymetallic veins, porphyry; 082FSW086, 87, 85, 254, 354	M: 3312 t grading 31.72 g/t Au I: 21,312 t grading 18.84 g/t Au Inf: 522,321 t grading 23.01 g/t Au (2009; non-compliant)	Option agreement; data compilation; surface work; permitting for underground decline, drilling, and bulk sampling; ML/ARD test work; environmental baseline; agreement for toll milling at Lexington (Greenwood) mill.
LH	Magnum Goldcorp Inc.	Cu-Ag-Au; Subvolcanic, skarn, Au-veins; 082FNW212	na	Drilling (4 DD holes, 250 m); results included 5.58 m grading 4.068 g/t Au, including 0.27 m grading 22.8 g/t Au.
Midway	KG Exploration (Canada) Inc.	Au-Cu-Pb-Zn- Ag+/-Mo; Cu-Au-Ag skarn, polymetallic vein, Au-vein, porphyry; 082ESW022, 210, 34, 221	na	Option agreement with Grizzly Discoveries Inc. to gain 75% interest in 27,346 ha; continued mapping and sampling at the Midway, Bruce Creek, and Kerr Creek. 2018 drilling (4 DD holes) encountered epithermal-style mineralization with low-grade, anomalous Au.

Monroe	Highway 50 Gold Corp.	Pb-Zn-Ag+/-Au, Cu; SEDEX; 082GSW069, 35, 41	na	Mapping, modelling; Drilling (2 DD holes, 1450 m) encountered fragmentals, moderate to intense albitization; bedded pyrrhotite-sphalerite; disseminations and veinlets of sphalerite and galena; thickened isopach sequences within the Aldridge Formation, suggesting sub-basin development.
Ore Hill	Apex Resources Inc.	Au+/-Ag, Pb, Zn; Au-quartz veins, polymetallic veins; 082FSW040, 48, 50, 51, 52, 53, 082FSE030, 31, 34, 25	na	Data compilation, mapping, rock sampling; 2 magnetic anomalies coincident with soil geochem anomalies and historic production; Drilling (600 m DD program) late in the year; visible gold in drill core.
Regal	Affinity Metals Corp.	Ag-Pb-Zn+/-Au; Polymetallic veins, SEDEX; 082N 004, 3, 16	Regal : 590,703 t grading 71.6 g/t Ag, 2.66% Pb, 1.26% Zn, 1.1% Cu, 0.13% Sn, 0.015% W (1982; non-compliant)	Drilling (1846 m; Regal: 10 DD holes, Allco : 11 DD holes); data compilation; 2011 ZTEM airborne geophysical survey; grab sampling (22 samples at Allco) with results up to 4420 g/t Ag, 2.27% Cu, 26.4% Zn, >20% Pb, and 5.68 g/t Au.
Silvana	Klondike Silver Corp.	Ag-Pb-Zn+/-Au; Polymetallic veins; underground; 082FNW050, 13, 082KSW006	-	Underground drilling (10 DD holes); facility upgrades; environmental monitoring; mill on care and maintenance; environmental baseline work.
Silver Dollar	Mariner Resources Corp. (Explorex Resources Ltd.)	Ag-Pb-Zn+/-Au, Cu; Polymetallic veins; 082KNW101, 127, 40, 46, 136	na	Option agreement; helicopter-borne high resolution magnetic and radiometric survey (621 line-km).
Silver Fox	Kootenay Silver Inc.	Cu-Ag; Sediment- hosted copper; 082GSW070, 72, 73	-	Drilling (6 DD holes, 3600 m); mapping, sampling; 3 rock samples assayed 0.104% Cu and 2.9 g/t Ag; 0.127% Cu and 9.9 g/t Ag; and 0.55% Cu, 14 g/t Ag, and 0.208 g/t Au; drill results pending.
Sweet Spot	Teck Resources Ltd.	Pb-Zn-Ag+/-Au; Polymetallic vein, SEDEX; 082GSW077	na	Drilling (2 DD holes, 1371 m); mapping; sampling; re-logging historic core; petrophysics; short wave near infrared spectral analysis; initial stages of exploration identified fragmental units, alteration assemblages, and indicators of SEDEX mineralization.
Thor	Taranis Resources Inc.	Ag-Pb-Zn+/-Au; Polymetallic veins and breccia, stratiform volcanogenic massive sulphide; 082KNW030, 31, 60, 61	I: 640,000 t grading 0.88 g/t Au, 187 g/t Ag, 0.14% Cu, 2.51% Pb, and 3.51% Zn; Inf: 424,000 t grading 0.98% Au, 176 g/t Ag, 0.14% Cu, 2.26% Pb, 3.2% Zn (2013)	Data compilation; update of geological model; environmental baseline studies; permitting for 10,000 t bulk sample.
Vine	PJX Resources Inc.	Pb-Zn-Ag+/-Au; Polymetallic vein, SEDEX; 082GSW050, 49, 35	1.3 Mt grading 2.2 g/t Au, 3.12% Pb, 36.3 g/t Ag, 3.12% Zn (1990 on Vine vein; non-compliant)	Drilling (12 DD holes, 4925 m); geophysical and geological modeling; drilling on magnetotelluric anomaly intersected 5.5 m zone of massive sulphide (pyrite, pyrrhotite, sphalerite).
Vulcan	Eagle Plains Resources Ltd.	Pb-Zn-Ag+/-Au; Polymetallic vein, SEDEX; 082FNE103, 101, 102, 104, 093, 160	na	Mapping, sampling, soil geochemistry, geophysical (IP and MT) survey; chip sample 1.6% Pb+Zn, and 10g/t Ag for 1.5 m.

M = Measured; I = Indicated; Inf = Inferred

 Table 5. Continued.

Provincial Overview of Exploration and Mining in British Columbia, 2019. British Columbia Geological Survey, Information Circular 2020-01

geochemical anomaly, whereas the eastern anomaly coincides with historic production from the Queen mine at its northern end. Apex mapped and sampled to confirm grades from the previous work and late in the year began a 600 m drill program, which encountered visible gold (Fig. 4).



Fig. 4. Visible gold in drill core (NQ size). Photo courtesy of Apex Resources Inc.

7.1.3. Kenville (Ximen Mining Corp.)

Ximen Mining Corp. optioned the Kenville property in 2019. The company began surface work and the permitting process for underground work, which proposes a new decline, bulk sampling, and underground drilling. The area is mainly underlain by mafic volcanic rocks of the Eagle Creek plutonic complex (Jurassic) which may be co-magmatic with volcanic rocks of the Elise Formation (Rossland Group). Nelson granodiorites (Late Jurassic), and Tertiary intrusive rocks are common in the immediate area. The predominant regional structural features are broad, north-trending and east-verging folds. The original past-producing Kenville mine, also known as the Granite-Poorman mine (Au-Ag-Pb-Zn-Cu), is classified as a gold-quartz vein deposit (Fig. 5) and consists of five northnorthwest trending veins that can be traced for at least 500 m with an average thickness of 0.6 m. It was the first underground lode gold mine in British Columbia and operated intermittently between 1890 and 1954. Historic production totalled 180,740 t averaging 9.07 g/t Au and 3.96 g/t Ag. In total, the mine produced 65,236 oz of gold, 27,686 oz of silver, 51,782 lbs of lead and 33,393 lbs of zinc. Exploration of the property since 1992, includes soil sampling, airborne EM geophysics, and both surface and underground drilling to test the southern extension of the veins and to define new targets.

7.1.4. Midway (KG Exploration (Canada) Inc.)

KG Exploration (Canada) Inc. (a wholly owned subsidiary of



Fig. 5. Quartz veins in the underground workings at the Kenville mine.

Kinross Gold Corporation) continued work in the Greenwood area in 2019. Kinross is targeting epithermal, skarn, and VMS mineralization in the northern extensions of the Republic and Toroda graben, on a land package optioned from Grizzly Discoveries Inc. At **Midway**, the target area is underlain by hydrothermally brecciated and intensely argillic-altered volcanic-sedimentary sequences interpreted to be part of the Marron Formation (Eocene). A silicified zone at the base of the Eocene unconformity in outcrop contains multiple narrow (to 0.5 m) chalcedonic quartz (+/-quartz breccia) veins. A soil geochemistry grid was completed on the property, and anomalies coincide with mineralization at surface. 2018 drilling (4 DD holes) encountered epithermal style mineralization with sporadic sulphides and low-grade, anomalous gold and silver in all 4 holes. Work in 2019 included detailed mapping and rock sampling at the Bruce Creek, Midway, and Kerr Creek areas to outline further targets for drilling in 2020.

7.1.5. Gold Drop (GGX Gold Corp.)

GGX Gold Corp. continued drilling and trenching at the **Gold Drop** property. The property is underlain by metamorphic rocks of the Knob Hill complex (Paleozoic) that have been intruded by granodiorite and diorite of the Nelson Plutonic suite and by biotite syenite and diorite/andesite dikes of the Coryell suite. The property hosts numerous north-trending, easterly dipping gold-bearing veins that are 10 cm to 2 m thick, distributed along steeply dipping strike-slip and normal faults. The veins postdate the Nelson intrusions, pre-date the Coryell suite, and are truncated by low-angle detachment faults. Between 1919 and 1941, the area saw small-scale production (Gold Drop, North Star, Amandy, and Rhoderick Dhu veins), from underground workings.

GGX Gold Corp. has been drilling at the Gold Drop, Everest

and C.O.D veins since 2017. Mapping, sampling and trenching has also identified several other veins, with values of 81.8 g/t Au and 630 g/t Ag in grab sample at the Everest vein, and up to 6.98 g/t Au and 38.6 g/t Ag at the Silent Friend and Ken veins. In 2019, the company continued to drill both the C.O.D. (48 DD holes, 2248 m) and C.O.D. North veins (10 DD holes, 685 m). The company also completed an airborne magnetotelluric survey and identified additional deeper drill targets for late 2019.

7.1.6. LH (Magnum Goldcorp Inc.)

Gold mineralization at the LH property appears to follow an east-west trending zone of fracturing, faulting, and silicification in a roof pendant of Rossland Group metavolcanic rocks (Lower Jurassic; Elise Formation) and early Jurassic subvolcanic equivalents. Gold is in a structural zone up to 13.7 m wide that contains mesothermal quartz lenses and veins 30 to 60 cm wide, and in silicified breccias and stockworks in hornfelsed volcanic rocks. Both styles of mineralization have elevated sulphides, including pyrite, pyrrhotite, arsenopyrite, and chalcopyrite. The company has been drilling the property in the past few years, with intersections including 8.5 m grading 7.10 g/t Au. Gold mineralization appears to be associated with pyrrhotite+/-arsenopyrite, which provide conductive targets that are coincident with ground geophysics magnetic anomalies. In 2018, the company expanded their magnetic grid, and obtained orthophotos using drones. In 2019, they completed a helicopter-supported drill program (4 DD holes, 250 m) to follow up on 2015 drilling, and on the western end of a magnetic anomaly. Present and historic drilling has identified at least two mineralized intervals 1 to 8.75 m thick. Highlight results from 2019 include 5.58 m grading 4.068 g/t Au, with 0.27 m grading 22.8 g/t Au.

7.2. Selected polymetallic base and precious metal projects

Base metals are explored for throughout the Omineca belt as SEDEX, VMS, manto and replacement deposits, and along structures in vein and fault systems.

7.2.1. Vine (PJX Resources Inc.)

The **Vine** property lies immediately north of the Moyie fault, a northeasterly trending structure, and a small north-trending graben. It is underlain by argillites and quartzites in the middle part of the Aldridge Formation. Historic trenching and drilling at the Vine vein revealed disseminated and bedded sulphides (pyrite, sphalerite, and galena) along a strike length of more than 1000 m, and to a depth of more than 700 m.

Gravity surveys identified two target areas (East and West) that are interpreted to have potential for massive sulphide mineralization (Pb-Zn-Ag±Au). A 3D magnetotelluric grid completed over the East anomaly late in 2018 highlighted a conductive zone that correlates with the gravity high. In 2019, PJX drilled (12 DD holes; 4925 m) and encountered anomalous zinc, copper, lead, and silver in two holes and a 5.5 m zone of massive sulphides. The zone is in the same horizon as a historic

hole 700 m to the south that graded 5.6% Zn, 2.7% Pb and 1.2 oz/t Ag for 3.4 m. Below the sulphide zone, the drilling also encountered a zone of granofels, bearing resemblance to the SEDEX deposit model of the historic Sullivan mine where granofels are adjacent to the main vent pipe.

7.2.2. Monroe (Highway 50 Gold Corp.)

Highway 50 Gold Corp. drilled (2 DD holes, 1450 m) at the **Monroe** property, targeting base metal sulphide mineralization in the Aldridge Formation. The property lies in a structural corridor at the intersection of two major fault zones, with numerous other showings, vent and breccia complexes, and abundant sericite, albite, chlorite, garnet and biotite alteration. Isopach variations, hydrothermal alteration, and distal-style mineralization may indicate proximity to growth faults and SEDEX mineralization in the Belt-Purcell basin (Lydon, 2007, 2010).

The company has been drilling since 2015, as a follow up on geochemical soil anomalies and geophysics. They have intersected thickened sequences in the Aldridge Formation, albitized and tourmalinized zones, fragmental units, carbonate beds, and abundant sericite and chlorite alteration. Mineralization occurs as disseminations, bedded and laminated pyrrhotite and sphalerite, pyrrhotite-biotite-chlorite-albite+/chalcopyrite veins, sphalerite and galena in tension cracks and veinlets, and sulphide-clast fragmental rocks.

7.2.3. Silver Fox (Kootenay Silver Inc.)

Kootenay Silver Inc. continued working at the Silver Fox property in 2019. The area is underlain by sedimentary rocks of the Purcell Supergroup (Mesoproterozoic); mainly rusty weathering argillites in the upper part of the Aldridge Formation, and quartzite, siltstone, and argillite of the Creston Formation. Stratabound copper mineralization is in the Creston Formation and includes chalcopyrite and malachite with accessory galena, arsenopyrite, bornite, and pyrite as disseminations, fracture fillings, and/or blebs. Pyrolusite and jarosite alteration appear associated with the mineralization. Mineralization is thought to be formed by hot, metal-enriched brines moving through porous sediments before lithification, with metals deposited at redox interfaces. Antofagasta plc dropped their option agreement on the property after 2018, but Kootenay Silver followed up on anomalies from sampling and ground geophysics and drilled 6 DD holes (3600 m) in 2019. Grab samples include grades up to 0.55% Cu, 14 g/t Ag, and 0.208 g/t Au.

7.2.4. Sweet Spot (Teck Resources Ltd.)

Teck Resources Ltd. continued work at the **Sweet Spot** property in 2019. The area is underlain by Purcell Supergroup rocks, with extensive stratabound and discordant fragmental units and widespread albite-tourmaline-chlorite-sericite alteration. Recent focus in the Purcell anticlinorium has been on geophysical methods to further identify structures and thickness variations in the Aldridge Formation that may indicate sub-basin development and potential SEDEX mineralization.

Cook (2017) indicated that magnetotellurics could highlight conductive subsurface horizons, providing another tool for SEDEX targeting.

In the last several years, the company has re-logged core, mapped, and sampled and identified target areas. They conducted additional geophysical work, including magnetotelluric studies to delineate targets, and in 2019 they drilled (2 DD holes, 1371 m). They also continued mapping, conducted petrophysical studies, and used short wave near infrared spectral analysis tools in their work.

7.2.5. Vulcan (Eagle Plains Resources Ltd.)

Eagle Plains Resources Ltd. continued work on their **Vulcan** property in 2019. The property is underlain by argillites and quartzites in the lower and middle parts of the Aldridge Formation, and hosts numerous showings. A high-resolution VTEM airborne geophysical survey was flown in 2005, and several anomalies were defined. Historic drilling (Cominco, 1985) reported pyrite/pyrrhotite laminations and "pervasive albite-tourmaline alteration and fracture/vein-controlled Pb/Zn mineralization". The company compiled the data, mapped, sampled and completed soil geochemistry on the property to further constrain targets. A chip sample from the main mineral occurrence (Hilo 3; MINFILE 082FNE103) returned 1.6% Pb+Zn and 10 g/t Ag along 1.5 m. In 2019, the company completed a ground IP and scalar magnetotelluric survey along approximately 3.0 line-kilometres.

7.2.6. Bull River mine, Empire Strathcona, and Rex (Braveheart Resources Inc.)

Braveheart Resources Inc. purchased the **Bull River mine** in 2019, which has been on care and maintenance since 2009. The property is in fault-bounded blocks of the Aldridge Formation. Cu-Ag mineralization is in a network of east-trending, nearvertical, sulphide-bearing quartz-carbonate veins, in sheared and brecciated host rocks. The main vein structure and stringer zones range from a few cm to 30 m wide. Mineralization occurs as pyrite, pyrrhotite, and chalcopyrite, with minor galena, sphalerite, arsenopyrite, cobalite, and traces of tetrahedrite and native gold. The historic Dalton mine operated between 1971 and 1974, and produced 7260 t of Cu, 6354 kg of Ag, and 126 kg of Au from 471,900 t milled (MINFILE) from open pits. The property has existing infrastructure, including a 750 tpd conventional mill, assay and metallurgical laboratories, tailings impoundment, waste dumps, and two open pits. Currently stockpiled on surface are 165 kt grading 1.7% CuEq. In 2019, the company completed condemnation drilling (6 DD holes, 618 m) on the mine property for planning purposes and environmental baseline work. In addition, they completed exploration drilling at the Empire-Strathcona (14 DD holes, 1389 m) and Rex properties (11 DD holes, 1697 m), which are to the southeast of the main mine property. Currently updating their major mines permit and working towards restart, the company plans to use the mill to process ore from their Alpine property.

7.2.7. Thor (Taranis Resources Inc.)

Taranis Resources continued work at the **Thor** property, which has several targets, and showings, including the True Fissure, Great Northern, Broadview, and Blue Bell pastproducing mines. The Thor property is underlain by a thick succession of folded and faulted sedimentary and volcanic rocks of the Badshot Formation and Lardeau Group. Parallel horizons of massive and disseminated galena, chalcopyrite, pyrite, and sphalerite (Ag-Pb-Zn-Au-Cu) extend along a 2 km strike length of a sheared, northwesterly trending anticline. The zone of mineralization is commonly intercalated with tuffaceous pyroclastic rocks. Drilling encountered foliated quartz-feldspar porphyry, which is considered to pre-date structures and possibly be related to the mineralizing event. High-grade gold is also found in late quartz veins and breccia zones that flank the main zone of sulphide mineralization.

In 2019, the company obtained a collection of maps, crosssections, and logs from Granby Consolidated Mining, Smelting and Power Company Ltd. for the underground workings at the True Fissure and Blue Bell mines. The files were for work conducted between 1930 and 1970. They compiled the data into their geologic model, and re-mapped and re-interpreted host structures to better understand the controls on mineralization and identify new targets. They also continued environmental baseline work for a 10,000 t bulk sample permit and a drill permit application at the Ridge target.

7.2.8. Silvana (Klondike Silver Corp.)

Klondike Silver Corp's Silvana project consists of 25,000 ha with more than 68 past producers, in the silver-rich historic Slocan mining camp (Ag-Pb-Zn), with production that dates back to 1891. The area is underlain by sheared and brecciated metasedimentary rocks of the Slocan Group (Late Triassic) that are cut by granodiorite and quartz monzonite dikes, and at the edge of the Nelson batholith (Middle Jurassic). Ag-Pb-Zn mineralization occurs in a series of east to northeast-trending, shear zone-hosted polymetallic veins, and as replacement in Slocan Group limestones. Klondike's holdings include 68 past producers, such as the Sandon, Hewitt, Silverton Creek, Cody Creek, Payne, and Jackson Basin camps, and the Silvana, Wonderful and Hinckley. The main vein at Silvana is in an eight km-long structure that yielded about 242 t Ag, 28,691 t Pb, 26,299 t Zn and 72 t Cd from 510,964 t mined between 1913 and 1993, at an average grade of 13.87 oz/t Ag, 5.62% Pb, and 5.15% Zn (Hedley, 1952). Data compilation and 3D modeling of the past-producers in the Sandon camp suggests mineralized potential between the mined zones of the historic producers, offset by late-stage post-mineral faulting.

In 2017, the company began rehabilitating the 4625-foot portal at **Silvana**, and began drifting (80 m). In 2019, they began underground drilling (10 DD holes; Fig. 6) to test unmined zones and encountered sphalerite and galena in every hole. Environmental baseline work, monitoring, and engineering upgrades to the tailings facility and mill are ongoing as the company updates their mine plan and permit. The company's



Fig. 6. Underground drilling at the Silvana project.

mill at Sandon is a 100 tpd flotation mill that operated at an average rate of 40 tpd and has been on care and maintenance since 2003.

7.2.9. Duncan (Rokmaster Resources Corp.)

The **Duncan** property has been intermittently explored since the 1950s. The property is underlain mainly by the Mohican and Badshot formations but includes the upper part of the Hamill Group and lowermost rocks of the Index Formation (Lardeau Group). Structures are mainly tight, asymmetric, and overturned folds, and steeply dipping faults. Mineralized zones consist of pyrite, sphalerite, galena and minor pyrrhotite disseminated in dolomite and siliceous dolomite of the Badshot Formation.

Drilling by Cominco between 1989 and 1997 outlined zinclead mineralization along a 650 m strike length. Several zones of mineralization exist on the property as steeply dipping, stratiform bodies, on the east limb of the Duncan anticline.

Rokmaster previously compiled historic data and resampled historic drill core. Results include 7.5 m grading 6.2% Zn + 6.3% Pb, 4.8 m grading 11.4% Zn + 0.8% Pb, and 6.9 m grading 7.1% Zn + 4.6% Pb. New forestry cutblocks on the property in 2019 exposed additional outcrops, and additional mapping, soil geochemistry, and rock sampling was done. The company also conducted environmental baseline work, and drill permits were received late in the year.

7.2.10. Regal, Allco (Affinity Metals Corp.)

Affinity Metals Corp. has been working on the Allco and **Regal** properties, which are underlain by lower Paleozoic quartzites, argillites, and limestones of the Badshot Formation and Lardeau Group. Galena, sphalerite, chalcopyrite, tetrahedrite, and pyrite are in numerous showings as stratiform bodies, replacements, and veins. The **Regal** property hosts several past producing mines including Regal, Allco and Snowflake, which operated intermittently between 1936 and 1953, following vein structures. Reported reserves (1982;

non-compliant) were 590,703 t grading 71.6 g/t Ag, 2.66% Pb, 1.26% Zn, 1.1% Cu, 0.13% Sn and 0.015% W (MINFILE). A minor amount of ore was shipped between 1934 and 1937.

In 2011, Northaven Resources Corp. completed 1354 linekm of airborne geophysical work over the area and identified linear magnetic and conductive anomalies that are coincident with historic MINFILE showings. In 2018, Affinity Metals Corp. optioned the property, compiled historic data, and did additional mapping. At the **Allco** property, 22 grab samples assayed up to 4420 g/t Ag, 2.27% Cu, 26.4% Zn, >20% Pb, and 5.68 g/t Au. Further interpretation was done on the 2011 geophysical survey, and helicopter-supported drilling was completed late in 2019 at **Allco** (10 DD holes), and **Regal** (11 DD holes).

7.2.11. Silver Dollar (Mariner Resources Corp.)

In 2018, Mariner Resources Corp. entered into an option agreement on the Silver Dollar property, with Explorex Resources Ltd. They can earn 75% by fulfilling the terms of the option agreement over a four-year period. The property is in the historic silver-lead-zinc Beaton-Camborne camp along a 40-km long mineralized zone that contains numerous past producers along the Camborne fault. The rocks are folded and faulted metasedimentary rocks of the Lardeau Group (Broadview and Jowett formations; lower Paleozoic). Argentiferous tetrahedrite, pyrite, galena, and sphalerite occur in mineralized veins and shear zones, along with lesser chalcopyrite, pyrrhotite, and minor amounts of gold. Drilling in 1984 returned 2.1 m grading 229 g/t Ag, 1.0 g/t Au, 10.95% Zn, 4.04% Pb, and 0.29% Cu. Chip sampling completed by Happy Creek Minerals in 2013 included 1.8 m grading 16.8% Zn, 3.9% Pb, 1.67 g/t Au and 241 g/t Ag. Soil geochemistry completed in 2018 defined an anomaly 1.4 km long and 350 m wide with elevated silver, lead, zinc, and antimony. Late in 2019, Mariner Resources Corp. completed a helicopter-borne high-resolution magnetic and radiometric survey over the property to delineate the Camborne fault zone.

7.3. Selected industrial mineral projects

Industrial minerals are explored for throughout the region, including graphite, gypsum, magnesite, silica, rip rap, dimension stone, sand and gravel, limestone, dolomite, tufa, smelter slag, basalt, gabbro, marble, and phosphate.

7.3.1. Gibraltar (MGX Minerals Inc.)

In 2019, MGX Minerals Inc. continued to explore their silica projects. At the **Gibraltar** property, Mount Wilson Formation quartzite (Upper Ordovician) was quarried for a short time in 1967 (Red Cloud quarry; MINFILE). The only recorded production was a small trial shipment, which assayed 98.56% SiO₂. In 2018, MGX shipped a one-ton sample to an independent lab in Germany (Dorfner Anzaplan) for testing. Results indicated that the material could be suitable as medium quality feedstock for metallurgical-grade silicon metal production. They mapped and sampled on the property, reporting assay

results between 97.8 and 99.9% SiO_2 , and began an eight-hole drill program late in the year. In 2019, they drilled (5 DD holes, 200 m) to follow up on their 2018 work.

7.4. Selected coal projects

Coal exploration is ongoing in the Elk Valley, Crowsnest, and Flathead coalfields.

7.4.1. Coal Creek (Crowsnest Pass Coal Mining Ltd.)

Crowsnest Pass Coal Mining Ltd. continued environmental baseline studies, engineering, and pre-feasibility work at their **Coal Creek** property. The project is underlain by 11 coal zones 2 to 20 m thick. The company is evaluating three near-surface seams in the uppermost part of the Mist Mountain Formation that dip gently to the east for underground room-and-pillar mining. Drilling in 2012 indicated high-quality hard coking and PCI coal in the upper seams.

7.4.2. Elko (Pacific American Coal Limited)

Pacific American Coal Limited released results of their 2018 drilling, and continued work on their **Elko** project. The company began working on the project in 2015 and compiled all historical data into a model to outline the drill locations. Operating near the Flathead area, the company also has conducted extensive environmental baseline work and First Nations engagement to receive permits for exploration.

In the 2018 drilling (RC and large-diameter; 3451 m), six coal seams were encountered in the Mist Mountain formation, ranging in thickness from 2.41 to 12.70 m. Geological modeling suggests that these seams are continuous across the property. Three additional seams were encountered in the overlying Elk Formation, and range in thickness from 1.77 to 2.60 m. Coal quality test results indicate seven of the nine seams are mid-volatile, low-ash coking coal. The bottom two seams are mid-volatile, semi-hard coking coal to PCI metallurgical coal, but more work needs to be conducted to determine characteristics of a blended product.

The project is in the Crowsnest coalfield, targeting Kootenay Group (Jurassic-Cretaceous) coal seams in the McEvoy syncline. Block modeling indicates potential for a small opencut operation and a larger underground operation. In 2019, the company used 2018 drilling results to update their JORC resource estimate of 117.6 Mt Measured + 93.2 Mt Indicated + 92.3 Mt Inferred.

8. Geological research

Höy (2019) released updated maps in the Boundary region, Rioseco et al. (2019) studied the metamorphic evolution of the Purcell Anticlinorium and Kootenay Arc, and Kuppusamy and Holuszko (2019) are characterizing the Elk Valley coals for rare earth elements.

9. Summary

In 2019, exploration and mining continued in the region. Major mine development, expansion plans, and projects in the East Kootenay coalfields continue to advance. Mineable reserves at the Coal Mountain mine are depleted, and reclamation has begun to move the mine to closure, though the processing plant and facilities will remain operational. The Kootenay West gypsum mine was granted an environmental assessment certificate early in 2018, and construction on the project began in 2019. Exploration for SEDEX-style base metals continued in the Purcell anticlinorium, and for precious and base metals throughout the region. Several drill programs continued late into the year throughout the region because of late financing and permitting delays, and some programs were postponed until 2020.

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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 metal and coal continue in the region, most mining is for construction materials, mainly aggregates for local markets.

The area has one major polymetallic metal mine, **Myra Falls** (Nyrstar N.V.), one coal mine, **Quinsam** (ERP Compliant Fuels LLC), 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. 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.

Mine site exploration at **Myra Falls**, which began late in 2017, continued in 2018 and 2019. **Surespan Gold** and **Pemberton Hills** saw significant exploration programs, and more than 30 other exploration projects were tracked, mainly grass roots or early stage and small scale. There were signs of interest in northern Vancouver Island where mineral tenure coverage increased during the year.

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 Petroleum Resources, the Association for Mineral Exploration in British Columbia, and EY LLP. For the Southwest Region, exploration expenditures were estimated at \$4.9 million and exploration drilling was estimated at approximately 24,700 m (Clarke et al., 2020; EY LLP, 2020).

The total area under mineral, placer, and coal tenure in the region increased about 9% between October 2018 and November 2019 to 624,000 ha; the most notable increase was on northern Vancouver Island.

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



Provincial Overview of Exploration and Mining in British Columbia, 2019. British Columbia Geological Survey, Information Circular 2020-01

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 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 pastproducing 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. More recent 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 mélange deposits (Rusmore and Cowan, 1985; Brandon, 1989) and the Leech River complex, an assemblage of greenschist- to amphibolitegrade 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 Hozameen 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 in 2019. Aggregate operations in the region number in the hundreds and only the most prominent (e.g., those producing at least one million tpy) are reported here.

3.1. Metal mines

3.1.1. Myra Falls Operations (Nyrstar N.V.)

Nyrstar N.V. owns and operates the Myra Falls underground Zn-Cu-Pb-Ag-Au mine through a 100% owned subsidiary, Nyrstar Myra Falls Ltd. Trafigura Group Pte. owned 98% of parent Nyrstar after a restructuring arrangement in July 2019 and is negotiating to purchase the remaining 2%. Trafigura is a private company and not required to publish a production forecast for the year. After closing for compliance reasons in 2018, the mine reopened in April 2019 with a reported production of 1000 t Zn, 800 t Cu, 216,000 oz Ag and 1000 oz Au in concentrate in the first half. The company anticipated first shipments toward the end of 2019. The mine has a history of replacing reserves through exploration, and mine site exploration continued in 2019 with underground drilling. 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.

Mine	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2019 Production (based on Q1-Q3)	Reserves (December 31, 2018)	Resource (December 31, 2018)	Comments
Myra Falls	Nyrstar Myra Falls Ltd.	Zn, Cu, Pb, Ag, Au; G06:Noranda/ Kuroko massive sulphide;	Not reported	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	Production suspended for compliance reasons end of 2018. Restarted April 2019.
		092F 330, 71, 72, 73				exploration continued with 17,000 m drilling in 198 holes.

Table 1. Metal mines, Southwest Region.

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

Table 2. Coal mines, Southwest Region.

Mine	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2019 Production (based on Q1-Q3)	Reserves	Resource	Comments
Quinsam	Quinsam Coal Corporation (ERP Compliant Fuels LLC)	TC; A04:Bituminous coal; 092F 319	Not reported	Not reported	Not reported. Unofficial, non- compliant resources estimated at 40 Mt in 2013 by mine staff.	Placed on care and maintenance May 2019 and operator filed for bankruptcy in July. Produced about 200,000 t in 2018, the last full year of production.

HCC = hard coking coal; PCI = pulverized coal injection; TC = thermal coal; P = Proven; Pr = Probable; M = Measured; I = Indicated; Inf = Inferred

3.2. Coal mines

3.2.1. Quinsam (ERP Compliant Fuels LLC)

Quinsam is an underground coal mine that began commercial production of thermal coal in 1988. 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 approximately 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. are taking enquiries about sales of the company's assets.

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 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., U.S. Concrete, Inc. 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 Mt per year. 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

Mine	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2019 Production (based on Q1-Q3)	Reserves	Resource	Comments
Apple Bay (PEM 100)	Linceo Media Group Inc.	Silica+alumina; R12:Volcanic glass-perlite; 092L 150	na	na	na	Care and maintenance 2019.
Benson Lake	Benson Lake Carbonates ULC	High brightness carbonate; R09:Limestone; 092L 295	na	na	na	Care and maintenance 2019.
Blubber Bay	Ash Grove Cement Company	Limestone, dolostone; R09:Limestone; 092F 479	Up to 50,000 t dolostone annually	na	100+ years	Care and maintenance, most of 2019. Continues to ship dolomite on contract.
Bute Inlet	Ironwood Clay Company Inc.	Clay; E07:Sedimentary kaolin? (or illite)	na	na	na	Not active 2019. Glacial Bay Organic Clay Inc. extracts clay by hand nearby.
Cabin Group	Northwest Landscape and Stone Supply Ltd.	Landscaping stone	na	na	na	
Cox Station	Mainland Construction Materials	Aggregate; R15:Crushed rock; 092GSE103	Typically 2-3 Mtpy	na	na	
CTCT	Vancouver Island Marble Quarries Ltd.	Marble; R09:Limestone; 092E 020	Typically about 400 t annually	na	na	Supplies Matrix Marble and Stone Inc.
De Cosmos Lagoon	Ironwood Clay Company Inc.	Clay; E07:Sedimentary kaolin? (and/or illite); 092M 019	na	na	na	No production reported for 2019.
Earle Creek	Lafarge Canada Inc.	B12:Sand and Gravel	Typically >1 Mtpy	na	na	
Garibaldi Pumice (Vulcan/ Salal)	Garibaldi Pumice Ltd.	Pumice; R11:Volcanic ash; 092JW 039	Approx. 20,000 m ³ annually	na	11,396,000 m ³ pumice 4,990,000 m ³ pumicite (fines)	2014 resource. Additional exploration 2015, 2018, 2019.
Haddington Island	Adera Natural Stone Supply Ltd.	Dimension stone, Building stone; 092L 146	na	na	na	Not active every year.
Hardy Island	Hardy Island Granite Quarries Ltd.	Dimension stone, Building stone; R03:Dimension stone-granite; 092F 425	na	na	na	
Imperial Limestone	Imperial Limestone Co. Ltd.	Limestone; R09:Limestone; 092F 394	Approx. 250,000 t annually	na	50+ years	Production number is their high-quality product. Resource estimated at roughly 200 Mt.

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

Table 3. Continued.

К2	K2 Stone Quarries Inc.	Dimension stone, flagstone; R08:Flagstone; 092C 159	15,000-20,000 t annually	na	na	Number represents material extracted.
Mount Meager Pumice	Great Pacific Pumice Inc.	Pumice; R11:Volcanic ash; 092JW 039	na	na	na	
Orca	Polaris Minerals Corporation	B12:Sand and Gravel	Up to 6 Mtpy	P+Pr: 121.6 Mt (2005)	M+I: 134.1 Mt (2005)	Subsidiary of U.S. Concrete Inc. Exports to USA.
Pipeline Road (2)	Jack Cewe Ltd. and Allard Contractors Ltd.	B12:Sand and Gravel	na	na	na	Two adjacent operating sites.
Pitt River	Lafarge Canada Inc.	Aggregate; R15:Crushed rock; 092GSE007	Typically >1 Mtpy	na	na	
Sechelt	Lehigh Hanson Materials Limited	B12:Sand and Gravel	Typically 5-6 Mtpy	na	Several decades	
Spumoni	Northwest Landscape and Stone Supply Ltd.	Flagstone; R08:Flagstone; 092GNW100	na	na	na	Seasonal quarry.
Sumas Shale	Sumas Shale Ltd. (Lafarge Canada Inc., Clayburn Industrial Group)	Shale, clay, sandstone; B05:Residual kaolin; 092GSE024	About 500,000 t annually	na	50+ years	Approximately 55% shale, 45% sandstone for cement production.
Tahsis	Pacific West Stone Inc.	Marble; R09:Limestone; 092E 020	na	na	na	Previous owner obtained a quarry permit for Tahsis, but new owner proposed marble production from Leo D'Or site (bulk sample).
Texada Quarry	Texada Quarrying Ltd. (Lafarge Canada Inc.)	Limestone, aggregate; R09:Limestone; 092F 395	na	na	100+ years	Mostly produces limestone for cement manufacture. High brightness carbonate and aggregates also produced.
Treat Creek	Lehigh Hanson Materials Limited	Aggregate; R15:Crushed rock	na	na	na	Formerly a Jack Cewe operation, now Lehigh Hanson.

operates two of the largest aggregate quarries in the region (Earle Creek and Pitt River) each of which typically produces more than 1 Mt per year.

Pipeline Road is the site of large operations by Jack Cewe Ltd. and Allard Contractors Ltd. Together they produce more than 1 Mt most years. Cewe also operated a large quarry on Jervis Inlet at **Treat Creek** which is now operated by Lehigh Hanson Materials Limited They do not release yearly production figures.

Polaris Minerals Corporation, a subsidiary of U.S. Concrete Inc. operates the **Orca** quarry near Port McNeill, which produces sand and gravel mainly for export. The operation is currently permitted for up to 6 Mt per year, but the operator is proposing an increase. Polaris has 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. This site would supply up to 250,000 tpy of a crushed basalt product.

The **Cox Station** quarry, on the north side of Sumas Mountain, is operated by Mainland Sand and Gravels 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 2-3 Mtpy. The quarry employs 45-50 people.

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). Pacific West Stone Inc. also has a quarry permit near Tahsis and proposed quarry at the Leo D'Or site at Bonanza Lake.

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.

Haddington Island and **Hardy Island** have been two regular sources of dimension stone. The Haddington Island product (typically referred to as Haddington Island andesite) is a durable, resistant dacitic volcanic rock (70.5% silica), part of the Alert Bay volcanic belt (Neogene). Adera Natural Stone Supply Ltd. supplies the Haddington Island andesite as needed. Most of the product is used for restoration work on historic buildings, but it has also been used in modern monuments and buildings.

Hardy Island Granite Quarries Ltd. produces 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 that can be found on many older buildings in Vancouver and Victoria.

3.3.1. Texada (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, is capable of producing for more than 100 years. They produce about 3.5 Mt annually.

3.3.2. 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 300,000 tpy of high-purity product, most of which

is shipped to their parent company in Seattle. They also mine and stockpile a larger quantity of lower quality limestone. Quarrying at the Imperial site dates to the 1930s, and the current owners have operated it since the early 1950s. They anticipate reserves will last for more than 50 years.

3.3.3. Blubber Bay Quarry (Ash Grove Cement Company)

The **Blubber Bay** limestone quarry on Texada Island has remained mostly on care and maintenance since 2010, after more than 100 years of operation. It reopens for sufficiently large contracts. It can still supply limestone aggregate and continues to supply dolomite. It has a contract for 150,000 t and plans 75,000 tpy this year and next.

3.3.4. PEM 100 (Linceo Media Group LLC)

On northern Vancouver Island, the new operator of the **PEM 100** or Apple Bay quarry, Linceo Media Group LLC, left the site on care and maintenance, but with environmental monitoring ongoing. When operating, the quarry ships silica and alumina products from silicified and clay-altered rhyolitic flows and volcaniclastic rocks. The new operator is proposing exploration and a higher production rate, pending discussions with the lease holder.

3.3.5. Benson Lake (Benson Lake Carbonates ULC)

At the **Benson Lake** white carbonate deposit on northern Vancouver Island, new owner Benson Lake Carbonates ULC reported 2016 production totalling approximately 19,000 t. The quarry has been on care and maintenance since 2017.

3.3.6. 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.

3.3.7. 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 new site at the head of Bute Inlet, which is 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. Other individuals and companies supply the growing cosmetic clay market at smaller scales from locations on the central coast and Vancouver Island. Glacial Bay Organic Clay Inc. is extracting material by hand, also near the head of Bute Inlet. Generally, Mines Act permits are not required where material is collected by hand, and therefore some glacial marine clay operations are unreported.

3.3.8. 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**). Exploration on the property consisted of 14 test pits to further delineate the existing resource (Table 3). Neighbouring Great Pacific Pumice Inc. has been producing smaller quantities but have stockpiles in Squamish from which they can ship year-round.

3.3.9. K2 (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.

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 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 2019.

6.2. Proposed coal mines

In 2016, the BC Environmental Assessment Office terminated environmental assessment of the Raven Underground Coal mine project of Compliance Coal Corporation, and the region now 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 is the subject of an application to amend the Orca environmental certificate.

6.3.1. BURNCO Aggregate (BURNCO Rock Products Ltd.)

The **BURNCO** Aggregate Project in the McNab Creek Valley (Fig. 1) now has environmental certification and may proceed with British Columbia Mines Act and other permitting. The proposed sand and gravel mine would ramp up to a 1.6 Mtpy 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.

6.3.2. 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 2017-2019. The property contains resources of calcite- and dolomite bearing carbonate rock and gabbroic rock for potential use as aggregate.

6.3.3. Black Bear (Polaris Materials Corporation)

As noted above, Polaris Materials Corporation is including **Black Bear** 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 250,000 tpy of crushed basalt.

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 2019 (Table 5).

7.1. Selected precious metal projects

Precious metal prospects are found in a variety of settings in the region. There was one major exploration project in 2019, in addition to several smaller projects.

7.1.1. Surespan Gold (Privateer Gold Ltd.)

Privateer Gold Ltd. drilled at **Surespan** in the Zeballos gold camp, completing about 4400 m in 18 holes by the end of 2019. Some published intersections are consistent with narrow gold vein mineralization like that mined historically in the Zeballos Camp and include: 1386.5 g/t Au across 0.3 m in the recently discovered 88 vein; 5.81 g/t Au across 7.12 m in a 50 m step

Project	Operator (partner)	Commodity; deposit type; MINFILE	Reserves	Resource	Comments
Black Bear	Polaris Materials Corporation (Parent co. US Concrete, Inc.)	Aggregate; R15; na	na	na	Orca environmental certificate amendment Application Information Requirements approved for proposed 250,000 tpy near the Orca quarry.
BURNCO Aggregate	BURNCO Rock Products Ltd.	Aggregate; B12:Sand and Gravel; na	na	Approx. 20 Mt	Has environmental certification.
Sechelt Carbonate	Ballinteer Management Inc.	Limestone, dolostone, aggregate; R09:Limestone; R10:Dolomite; R15:Crushed rock; 093GNW031	na	Carbonate Rock: 76.1 Mt Gabbro: >700 Mt	Proponent requests project remain in environmental assessment pre-application stage.

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

out from the Prident mine; and 24.20 g/t Au across 0.55 m in an 80 m step out from the White Star mine. Privateer is a private company working mainly on Crown-granted mineral claims and is not obligated to release results. They acquired additional mineral Crown grants (Central Zeballos property) from CanAlaska Uranium Ltd.

7.1.2. Ladner Gold (New Carolin Gold Corp.)

At the Ladner Gold project, New Carolin Gold Corp. completed 850 m of underground drilling in two holes in the footprint of the Carolin Mine. They will await results before proceeding. The fall program also included surface mapping and rock and soil sampling to generate near-surface targets.

7.1.3. Hewitt Point, Margurete (Academy Metals Inc.)

Academy Metals Inc. (formerly Unity Metals Corp.) explored several contiguous properties adjacent to the Phillips Arm gold camp, including **Margurete** and **Hewitt Point**. Packsack drill and outcrop samples produced several results of greater than 10 g/t Au. Packsack drill results included a 2 m core sample grading 6.18 g/t Au and 8.1 g/t Ag and a 0.38 m sample grading 8.62 g/t Au and 3.8 g/t Ag. The area has been intermittently explored for gold-bearing quartz veins since the late 19th century. The Doratha Morton mine produced 4627 oz Au and 10,736 oz Ag, mostly in 1898-99 with minor production in 1925 and 1934. The area is underlain mainly by Coast Plutonic complex diorite to granodiorite with some volcanic rocks, hypabyssal intrusive rocks, and sedimentary and metamorphic rocks near intrusive contacts.

7.1.4. Gold Standard (DSM Syndicate)

DSM Syndicate returned to its gold vein discovery at Gold

Standard. Channel samples graded 5.86 g/t Au and 14.18 g/t Ag across 12 m, including 5 m of 12.66 g/t Au and 30.20 g/t Ag. They describe mineralization as orogenic quartz vein and shear hosted. Juggernaut Exploration Ltd., a partner in the DSM Syndicate, has agreed on an option deal to earn 100% interest in the property.

7.1.5. Gold Crest (DSM Syndicate)

Juggernaut Exploration Ltd. also reported discovery of a VMS target on DSM's **Gold Crest** property. A highlight of sampling included a 1 m chip sample grading 56.1 g/t Au and 124 g/t Ag.

7.1.6. Angus (Kootenay Zinc Corp.)

Kootenay Zinc optioned the **Angus** property from Longford Capital Corp. in September. Longford reported discovering a visually mineralized showing during reconnaissance work. Angus is about 7 km west of the Lara VMS prospect in Sicker Group and Buttle Lake Group rocks intruded by Mount Hall gabbro. Veins grading up to 13 g/t Au are reported historically.

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

Bayhorse optioned the **Brandywine** past producer and began compiling historical data and preliminary work at the site, including resampling of 2010 drill core. Metallic screen assays in some cases yielded significantly higher Au results (e.g., 11.42 vs. 3.73 g/t across 3.1 m and 20.20 vs. 6.23 g/t Au across 1.6 m). In 1977-78 about 10,000 t of ore from **Brandywine** yielded 23,000 oz Ag and 11,000 oz Au, with Pb, Zn and Cu co-products.

Project	Operator (partner)	Commodity; Deposit type; MINFILE	Resource (NI 43-101 compliant unless indicated otherwise)	Comments
Angus	Kootenay Zinc Corp.	Au, Ag, Cu, Zn; I05:Polymetallic veins; 092C 192	na	New showing reported.
Bakar	District Metals Corp.	Cu, Ag; D03:Volcanic Redbed Cu; 102I 010, 7, 6, 15, 16, 17, 092L 080, 462, 247	na	VTEM, mapping, channel samples returned high-grade Cu.
Brandywine	Bayhorse Silver Inc.	Ag, Au, Pb, Zn; I05:Polymetallic veins; 092JW 001, 21, 22	na	Core reanalysis. Metallic screen assays up to 20.2 g/t Au across 1.5 m.
Caledonia	Surge Exploration Inc.	Ag, Cu, Pb, Zn; K02:Pb-Zn skarns; 092L 061, 209	na	New operator.
Dancer Group	AMA Gold Exploration Ltd.	Au, Ag; Au- quartz veins, polymetallic veins; 092GNW008, 12, 63	na	Trenching, drilling (100 m).
Giant Copper	Imperial Metals Corporation	Cu, Au, Ag, Mo; Porphyry Cu±Mo±Au; 092HSW001, 2, 27, 161	Invermay zone I: 17,532,570 tons 0.226% Cu, 0.011 oz/t Au and 0.310 oz/t Ag AM Breccia zone Historical: 29,523,030 tons 0.653% Cu, 0.11 oz/t Au, 0.360 oz/t Ag, 0.007% Mo	Permitting.
Gold Crest	DSM Syndicate Holdings Ltd.	Au, Ag; Au quartz veins	na	Mapping, rock geochemistry. Highlight 56.10 g/t Au and 124 g/t Ag across 1 m.
Gold Standard	DSM Syndicate Holdings Ltd.	Au, Ag; I01:Au quartz veins, reported VMS target	na	Mapping, rock sampling. Highlight 5.81 g/t Au across 12 m.
Hewitt Point, Margurete	Academy Metals Inc.	Au, Ag; I01:Au quartz veins; 092K 025, 151, 187, 30, 20	na	Rock sampling, backpack drilling. Highlight 8.62 g/t Au over 38 cm. 6.18 g/t Au across 2 m.
Jack White	Kal Minerals Corp.	Cu, Fe; K01:Copper skarn, K03:Fe skarn; 092HNW026	na	Rock and soil sampling, ground magnetic survey, IP survey.

 Table 5. Selected exploration projects, Southwest Region.

Ladner Gold	New Carolin Gold Corp.	Au, Ag; I01: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	Drilling; 850 m underground. Surface mapping, rock and soil sampling.
MQ-Nimpkish- Bonanza	Graymont Western Canada Inc.	Limestone; R09:Limestone; 092L 186	na	Geophysical work spread across several northern Vancouver Island properties.
Pacifico	Silver Grail Resources Ltd.	Co, Cu, Au; Deposit type undefined; 092L 370	na	Grassroots project. Silt sampling.
Pemberton Hills	Northisle Copper and Gold Inc. (Freeport- McMoRan Mineral Properties Canada Inc.)	Cu, Mo; L04:Porphyry Cu±Mo± Au; 092L 131, 308	na	Drilling 3400 m in 6 holes. IP, geochemistry.
Peneece	Delrey Metals Corp.	Magnetite, Ti, V; M05:Alaskan type; 092M 010, 1	na	Airborne magnetic survey. Deposit type is speculative.
Rogers Creek	Tocvan Ventures Corp.	Cu, Mo, Au, Ag; L04:Porphyry; 092JSE033, 34, 35, 36	na	Geochemistry, IP.
Surespan Gold	Privateer Gold Ltd.	Au, Ag; I01:Au-quartz veins; 092L 008, 311, 155	Historical: 122,470 t at 9.26 g/t Au and 324,772 t at 15.09 g/t Au	Drilling 4400 m in 18 holes.
Teeta Creek	ArcWest Exploration Inc.	Cu, Mo, Au; L04:Porphyry	na	Mapping, prospecting, rock sampling. Highlight 21.1 g/t Au.
Wahleach Creek	Inua Studio	Jade; Jade (Nephrite); 092HSW099	na	Trenching, prospecting.
Yreka	Karmamount Mineral Exploration Ltd.	Cu, Ag, Au; K01:Cu skarns, L04:Porphyry; 092L 052, 104, 451, 336, 236, 105, 452	na	IP. Testing for porphyry-style mineralization west of known skarn.

M = Measured; I = Indicated; Inf = Inferred

7.1.8. Dancer Group (AMA Gold Exploration Ltd.)

AMA continued trenching and drilling at the **Dancer** claims. They drilled about 100 m targeting gold veins in Coast Plutonic complex diorite to granodiorite.

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. Pemberton Hills (Freeport McMoRan Inc. 65%; Northisle Copper and Gold Inc. 35%)

In 2018, NorthIsle Copper and Gold Inc. optioned the **Pemberton Hills** area of its North Island property to Freeport-McMoRan Mineral Properties Canada Inc. Work in 2019 included IP, geological mapping, geochemistry, and clay studies to refine possible winter drill targets. A large area of advanced argillic alteration in the Pemberton Hills area (Fig. 2) stretches westward more than 10 km to the **Hushamu** deposit. Minor base and precious metals have been reported in the Pemberton Hills area, but it has not been systematically tested at depth.



Fig. 2. Pemberton Hills, silica-clay altered rhyolite with sheeted quartz veins, interpreted as a leached cap above mineralization in the Hushamu area.

7.2.2. Giant Copper (Imperial Metals Corporation)

Imperial Metals Corporation proposes drilling (5 trenches and 5 drill sites) at its **Giant Copper** project. The Notice of Work application is in process. In the last several years, Imperial has reported geological work and rock and soil geochemistry at the site that have pointed to a high-grade gold discovery at the Otis zone, east of most past exploration. The company hopes to follow up with trenching and drilling. The Giant Copper property includes the AM Breccia for which there is a historical resource, and the Invermay Breccia, a minor past producer, for which there is a 2006 resource. Porphyry mineralization at depth in the AM Breccia is also a target.

7.2.3. Rogers Creek (Tocvan Ventures 80%; Carube Copper Corp. 20%)

Tocvan carried out rock sampling, IP, and short-wave infrared examination of drill core at Rogers Creek. Targets are Miocene porphyry copper occurrences, part of a belt extending from approximately the US border through Pemberton.

7.2.4. Teeta Creek (Teck Resources Limited 60%; ArcWest Exploration Inc. 40%)

During mapping and sampling reconnaissance work, ArcWest Exploration Inc. sampled up to 21.2 g/t Au and 15 g/t Ag in an apparent epithermal zone at their **Teeta Creek** project (Fig. 3), primarily known as a porphyry Cu-Mo prospect. Preliminary Re-Os molybdenite geochronology suggests a young (Miocene) age of mineralization (Nixon et al., 2020). The area was drilled in 1968 and 1975 with at least one encouraging copper intersection. Teck Resources Limited has entered into an agreement to explore the property to earn an initial 60%.

7.2.5. Yreka (Karmamount Mineral Exploration Inc.)

Karmamount carried out an IP survey at their Yreka project to test possible porphyry stockwork mineralization west of the Yreka past Cu-Au-Ag producer. Lines also extended over the known Cu-Au skarn mineralization.



Fig. 3. Teeta Creek, hydrothermal breccia with intensely clay altered felsic volcanic clasts in a chalcedonic matrix.

7.3. Selected polymetallic base and precious metal projects

With the exception of a program at Myra Falls, volcanogenic massive sulphide deposits in the southwest saw limited exploration in 2019. The precious metals-enriched **Brandywine** is included under the precious metals section, above. A new project in 2019, **Bakar**, has volcanic red bed copper occurrences.

7.3.1. Bakar (District Metals Corp.)

District Metals reported channel sampling up to 10 m of 4.92% Cu and 28 g/t Ag at its newly acquired **Bakar** property. The initial program included rock, soil and stream-sediment sampling, and an airborne versatile time-domain electromagnetic survey. Known mineralization includes copper-silver vein and volcanic red bed copper showings.

7.3.2. Pacifico (Silver Grail Resources Ltd.)

Silver Grail reported silt sampling of five streams. This follows preliminary prospecting and silt sampling in 2018. **Pacifico** is a grass roots to early stage Cu-Co-Mn property.

7.4. Selected skarn projects

7.4.1. Caledonia (Surge Exploration Inc.)

Surge Exploration optioned the **Caledonia** property northeast of Freeport McMoRan's Pemberton Hills project. Following due diligence work, they expanded the property to allow exploration along strike. **Caledonia** is a skarn at contacts between Vancouver Group limestone and basalt with Island Plutonic suite granodiorite. It has an historical (non-compliant) resource of 68,000 t grading 704.2 g/t Ag, 6.1% Cu, 7.45% Zn, 0.6% Pb and 0.34 g/t Au. The 3 to 5 m wide zone has a strike length of 100 m.

7.4.2. Jack White (Kal Minerals Corp.)

Kal Minerals conducted an initial program at its **Jack White** property including mapping, rock and soil sampling, a ground magnetic survey, and a 3D IP survey. They obtained up to 44% Fe and 4745 ppm Cu in grab samples.

7.5. Selected specialty metals and industrial mineral projects

Carried out by private companies, exploration for industrial minerals commonly goes unreported. Probably the most common type of exploration is bulk sampling for test marketing purposes. This is typically done by building and landscaping stone producers. Exploration for specialty metals is more likely to be carried out by publicly traded exploration companies.

7.5.1. Peneece (Delrey Metals Corp.)

Delrey flew an airborne survey and identified a large magnetic anomaly at its **Peneece** iron-titanium-vanadium project. Delrey increased the size of their land holdings to cover the anomaly. Previously called **Wigwam Magnetite**, this prospect comprises a large, low-grade (5-10%) titaniferous magnetite deposit. Magnetite also has elevated vanadium. It was first recognized as a large magnetic anomaly in the late 1950s or early 1960s. Relatively little work has been done, but it appears as though diorite, metasedimentary and metavolcanic rocks host fine- to coarse-gabbro or hornblende pyroxenite dikes or veins with 5-10% magnetite.

7.5.2. Wahleach (Inua Studio)

Trenching and prospecting continued in the Wahleach Creek area seeking jade. Some A-grade nephrite is reported. Quarrying of slate is also under consideration.

7.5.3. MQ-Nimpkish-Bonanza (Graymont Western Canada)

Graymont reported geophysical work on its northern Vancouver Island limestone properties.

8. Geological research

Rukhlov et al. (2020) conducted a multi-media geochemical and Pb isotopic survey on northern Vancouver Island from streams draining prospective rocks of the Bonanza arc. Water, stream sediment, sluice heavy metal concentrate samples were taken to optimize geochemical techniques at the property level and to refine provincial-level surveys. Also on Vancouver Island, Nixon (2011a, 2011b) obtained unexpectedly young U-Pb ages (Miocene) from intrusive rocks in the Klaskish River area as part of a regional mapping project. Nixon et al. (2020) provide new preliminary high-precision U-Pb zircon and Re-Os molybdenite ages for mineralized stocks of the Klaskish Plutonic Suite (ca. 7-4.6 Ma) that confirm emplacement coeval with older phases of Alert Bay volcanism (8-2.5 Ma), and that porphyry Cu-Mo magmatic-hydrothermal systems are genetically linked to pluton emplacement and crystallization. This young Cu-Mo porphyry mineralization forms a well-defined metallotect that is underexplored and rich in opportunities for discovering economic deposits. Truman and Clift (2019) provided background on a 250-m spaced aeromagnetic and radiometric survey across northern Vancouver Island, anticipating that results will be released in early 2020.

Grasby (2019) has been examining the geothermal resources of the Garibaldi belt in a project that includes geological mapping, passive seismic, magnetotelluric and gravity surveys. Work has been carried out intermittently at Mount Meager since the 1970s, including a test well in the 1980s.

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