

Provincial Overview of Exploration and Mining in British Columbia, 2018



Ministry of Energy, Mines and Petroleum Resources



Ministry of Energy, Mines and Petroleum Resources British Columbia Geological Survey Information Circular 2019-01

British Columbia Geological Survey Ministry of Energy, Mines and Petroleum Resources





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Front Cover: Gossan in Stuhini Group volcanic rocks, North Central Region. Photo by Paul Jago.

Back Cover: Core storage facility, Akie project (Canada Zinc Metals Corp.), North Central Region. Photo by John DeGrace.

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> Victoria British Columbia Canada

> > January 2019

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 2019-02).

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 Ernst & Young 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, 2019

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Exploration and mining in British Columbia, 2018: 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. An increase in commodity prices early in 2018 meant numerous mineral exploration projects remained active in 2018 (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 2019-02) 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 2018 at \$10.93 billion (Fig. 3) including coal, copper, gold, industrial minerals, aggregate, molybdenum, and silver. This is an increase of \$2.09 billion over the 2017 preliminary NRCan estimate of \$8.84 billion (Fig. 4). The increase is mostly due to an increase in coal and copper production, and higher commodity prices, particularly for coal and copper and, to a lesser degree, gold. However, the price of copper dropped during the year, from a peak of more than \$3.20 per pound to \$2.71 per pound at years end. As in previous years, coal was the highest value mine product (58%) followed by copper (25%).

In 2018, eleven metal mines operated during at least part of the year (Fig. 1; Table 2). Coal was produced at five large openpit operations in the southeastern part of the province, three open-pit operations in the northeastern part of the province and one underground mine on Vancouver Island (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 \$3.83 billion (forecast) of all mine production in 2018, representing about 35% of total output (Fig. 3). Eleven mines were producing in 2018.

In the Northwest Region, steady production was announced for the **Brucejack** mine. For the first three quarters ending September 30th, production totalled 279,670 oz Au and 308,676 oz Ag from 738,555 t of ore grading 12.0 g/t Au. Gold recoveries averaged 97.4%. In December 2018, Pretium Resources Inc. received approval from the British Columbia Ministry of Energy, Mines and Petroleum Resources and Ministry of Environment and Climate Change Strategy to increase production from 2700 tpd to 3800 tpd. Also in the Northwest Region, Imperial Metals Corporation reported that production from the **Red Chris** copper-gold mine to the end of the 3rd quarter totalled 44.78 Mlbs Cu and 29,569 oz Au from 7.93 Mt of ore grading 0.34% Cu and 0.25 g/t Au. Metal recoveries averaged 75.39% for Cu and 45.82% for Au.

In the North Central Region, the **Mt. Milligan** open-pit copper-gold mine was is in its sixth year. Production to the end of the 3rd quarter totalled 35.3 Mlb of Cu and 134,722 oz Au from 9.80 Mt of ore grading 0.21% Cu and 0.69 g/t Au. Metal recoveries averaged 81.10% for Cu and 63.5% for Au.

In the South Central Region, operating mines included **Bonanza Ledge**, **Copper Mountain**, **Gibraltar**, **Highland Valley**, **Mount Polley** and **New Afton**. As of December 2018, Barkerville Gold Mines Ltd. mined 120,000 t at a diluted grade of 6.65 g/t Au from **Bonanza Ledge**. Initial life-of-mine is a planned 3.5 years at 150,000 tpy, but there is exploration





Fig. 2. Geographic regions and Regional Geologist offices.

potential. Ore is trucked to Barkerville's QR mill, which is permitted for up to 875 tpd. They reported throughput up to 800 tpd and 91.6% recovery, which may improve with recommissioning of a gravity circuit.

Copper Mountain Mining Corporation reported that production at **Copper Mountain** to the end of the 3rd quarter totalled 58.2 Mlbs Cu, 20,100 oz Au and 211,200 oz Ag from 10.66 Mt of ore grading 0.31% Cu at 79.4% recovery. An exploration program at the mine site continued in 2018, with four holes in the east wall of Pit 3. Northwest of current mining at New Ingerbelle, a second phase of drilling included 10,616 m in 29 holes. The Measured and Indicated resource estimate for New Ingerbelle stands at 151.3 Mt 0.29% Cu and 0.18 g/t Au, applying a 0.16% Cu cut-off, or 195.6 Mt 0.26% Cu and 0.16 g/t Au applying a 0.12% Cu cut off. A basecase preliminary economic assessment indicated favorable economics using the existing mill.

The **Gibraltar** mine reported production to the end of the 3rd quarter totalled 99.4 Mlb of Cu and 1.64 Mlb Mo from 22.9 Mtons of ore. For the 3rd quarter a copper grade of 0.314% at a recovery of 85.9% was reported.



Fig. 3. 2018 forecast value of British Columbia mineral production by commodity; total is \$10.93 billion.

In the first nine months of 2018, Teck Resources Ltd.'s **Highland Valley** mine milled 36.964 Mt at a Cu grade of 0.23% and recovery of 78.9%. For the full 2018 year, the company projects 100 to 105 Mt Cu and 7.7 Mlb Mo in concentrate. Teck proposes to extend mining to the past-producing Bethlehem deposit, where it has defined about 100 Mt of ore that could feed the Highland Valley 140,000 tpd mill. An application for a first phase of development is under review with the Ministry of Energy, Mines and Petroleum Resources.



Fig. 4. Value of British Columbia mineral production by year, 1998-2018; value for 2017 is preliminary estimate, value for 2018 is forecast.

Region	Community	Regional Geologist	Phone	email
Northwest	Smithers	vacant	-	-
Northeast and North Central	Prince George	John DeGrace	250-565-4316	John.Degrace@gov.bc.ca
South Central	Kamloops	vacant	-	-
Southeast	Cranbrook	Fiona Katay	250-417-6010	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

Table 1. Regional Geologists contact information.

Table 2. Operating metal mines	, 2018, forecast mine	production, reserves, and	1 resources.
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Mine	Region	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2018 Production (based on Q1- Q3)	Reserves	Resource	Comments
Brucejack	Northwest	Pretium Resources Inc.	Au, Ag; Au-quartz veins, quartz stockwork breccia, epithermal; 104B 193	372,900 oz Au, 411,600 oz Ag	P+Pr: Combined VOK zone and West zone 18.5 Mt at 14.6 g/t Au, 53.5 g/t Ag	M+I: VOK zone 16.4 Mt at 17.2 g/t Au and 15.0 g/t Ag M+I: West zone 4.9 Mt at 5.85 g/t Au and 267 g/t Ag. Resources are inclusive of reserves.	Announced steady production in 2 nd quarter. Received government approval to increase production rate to 3800 tpd from 2700 tpd.
Red Chris	Northwest	Red Chris Development Company Ltd.	Cu, Au, Ag; porphyry Cu-Au; 104H 005	59.71 Mlbs Cu, 39,425 oz Au and 102,733 oz Ag	P+Pr: 301.5 Mt at 0.36% Cu, 0.27 g/t Au	M+I: 1.035 Bt at 0.35% Cu, 0.35 g/t Au and 1.14 g/t Ag	First year of full production in 2016. Reserve and resource figures are for combined open-pit and planned underground operations and do not take into account mining since start-up.
Silvertip	Northwest	Coeur Mining Inc.	Ag, Pb, Zn, Au; polymetallic manto; 104O 038	na	na	I: 2.59 Mtons at 10.26 oz/ton Ag, 6.74% Zn, 9.41% Pb	Commercial production declared in September. Mine site drilling returned results including 11.4 m of 193.3 g/t Ag, 18.3% Zn and 3.2% Pb and located new mineralization.
Mt. Milligan	Northeast	Centerra Gold Inc. (Centerra B.C. Holdings)	Cu, Au, Ag; alkalic porphyry Cu-Au; 093N 194, 191	40-47 Mlbs Cu, 175- 195 Koz Au	P: 236.5 Mt at 0.187% Cu and 0.424 g/t Au Pr: 239.4 Mt at 0.188% Cu and 0.293 g/t Au	M+I: 243.9 Mt at 0.16% Cu and 0.2 g/t Au (additional to reserves)	Concentrator design capacity 62,500 tpd. Estimated mine life 22 years. More than 350 employees.
Bonanza Ledge	South Central	Barkerville Gold Mines Ltd.	Au; Au- quartz veins; 093H 140	120,000 t at 6.65 g/t Au diluted (as of December)	na	M: 264,000 t 7.3 g/t Au I: 508,300 t 6.2 g/t Au Inf: 173,400 t 4.6 g/t Au	Long hole and cemented rock fill.

Table 2.	Continued.
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Copper Mountain	South Central	Copper Mountain Mining Corporation 75%, Mitsubishi Materials Corporation 25%	Cu, Au, Ag; porphyry Cu- Au, alkalic; 092HSE001	80 Mlb Cu, 27,500 oz Au, 300,000 oz Ag (management's guidance)	P+Pr: 210,079 Kt 0.26% Cu, 0.08 g/t Au, 0.89 g/t Ag	M+I: 322,755 Kt 0.26% Cu, 0.08 g/t Au, 1.05 g/t Ag Inf: 111,855 Kt 0.21% Cu, 0.08 Au, 0.63 g/t Ag	Resources inclusive of reserves. Excludes New Ingerbelle: M+1: 195,647 Kt 0.26% Cu, 0.16 g/t Au, 0.50 g/t Ag Inf: 93,459 Kt 0.23% Cu, 0.14 g/t Au, 0.43 g/t Ag.
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 (management's guidance)	P+Pr: 668 Mtons 0.26% Cu, 0.008% Mo	M+I: 1011 Mtons 0.25% Cu, 0.008% Mo	Resources inclusive of reserves.
Highland Valley	South Central	Teck Resources Limited	Cu, Mo; porphyry Cu+/- Mo+/-Au; 092ISW012, 45	102,500 t Cu, 3266 t Mo (management's guidance)	P+Pr: 589.5 Mt 0.300% Cu, 0.007% Mo	M: 488.4 Mt 0.31% Cu, 0.009% Mo I: 882.6 Mt 0.23% Cu, 0.009% Mo Inf: 382.4 Mt 0.23% Cu, 0.007% Mo	Resources exclusive of reserves.
Mount Polley	South Central	Imperial Metals Corporation	Cu, Au, Ag; porphyry Cu- Au, alkalic; 093A 008	15.6 Mlb Cu, 39,500 oz Au (management's guidance)	P+Pr: 58.272 Mt 0.33% Cu, 0.30 g/t Au, 0.86 g/t Ag	M+I: 206.22 Mt 0.285% Cu 0.28 g/t Au, 0.67 g/t Ag Inf: 7.519 Mt 0.308% Cu, 0.24 g/t Au, 1.66 g/t Ag	Reserves in 5 zones. Resources inclusive of reserves. Shutdown of operations announced early 2019.
New Afton	South Central	New Gold Inc.	Au, Ag, Cu; porphyry Cu- Au, alkalic; 092INE023	55,000- 65,000 oz Au, 75-85 Mlb Cu (guidance) 64.3 Mlb Cu, 58.551 Koz Au, 200 Koz Ag (Q3 actual)	P+Pr: 54.867 Mt 0.61 g/t Au, 2.0 g/t Ag, 0.78% Cu	M+I: 58.038 Mt 0.63 g/t Au, 2.1 g/t Ag, 0.76% Cu Inf: 15.253 Mt 0.39 g/t Au, 1.3 g/t Ag, 0.41% Cu	A, B and C zones + HW lens resources. Resources exclusive of reserves.
Myra Falls	Southwest	Nyrstar Myra Falls Ltd. (parent company Nyrstar N.V.)	Zn, Cu, Pb, Au, Ag; Noranda/ Kuroko massive sulphide; 092F 072, 330, 71, 73	na	P+Pr: 4.89 Mt 6.84% Zn, 0.75% Pb, 0.91% Cu, 71.31 g/t Ag, 1.69 g/t Au	M+1: 7.29 Mt 6.59% Zn, 0.72% Pb, 1.01% Cu, 69.71 g/t Ag, 1.76 g/t Au Inf: 0.94 Mt 9.51% Zn, 1.05% Pb, 0.83% Cu, 136.78 g/t Ag, 2.90 g/t Au	Production ramp up in 2018. Resources inclusive of reserves Dec. 31, 2017.

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

Table 3. Operating coal mines, 2018	8, forecast mine production, reserves, and resource	S.
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Mine	Region	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2018 Production (based on Q1-Q3)	Reserves	Resource	Comments
Brule	Northeast	Conuma Coal Resources Limited	PCI; bituminous coal; 093P 007	2.47 Mt ROM	P: 14.8 Mt saleable	na	About 230 employees. November 2018, began on- lease exploration program to extend resource base.
Willow Creek	Northeast	Conuma Coal Resources Limited	HCC, PCI; bituminous coal; 093O 008	482,000 t ROM	P: 16.1 Mt saleable	na	About 220 employees, mine and plant. Restart began in July 2018. On- lease exploration program to extend resource base.
Wolverine (Perry Creek)	Northeast	Conuma Coal Resources Limited	HCC; bituminous coal; 093P 025	1.89 Mt ROM	P: 6.9 Mt saleable	na	About 300 employees, mine and plant. December 2018. Began on-lease drill program to help set the parameters for underground mining.
Coal Mountain	Southeast	Teck Coal Limited	PCI	615,000 t clean	na	na	Mineable resource at CMO depleted in Q3 2018; reclamation begun; facilities continue to process 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%)	НСС	6.7 Mt clean	HCC P: 7.4 Mt Pr: 286.1 Mt	HCC M: 379.5 Mt I: 164.2 Mt Inf: 245.3 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 42 more years at the current production rate.

Fording River	Southeast	Teck Coal Limited	НСС	9.0 Mt clean	HCC P: 161 Mt Pr: 221.5 Mt	HCC M: 430.5 Mt I: 938.2 Mt Inf: 787.8 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 45 years of mining at current production rate.
Greenhills	Southeast	Teck Coal Limited (80%); POSCAN (20%)	НСС	6.1 Mt clean	HCC P: 10.6 Mt Pr: 154.6 Mt	HCC M: 176.6 Mt I: 247.1 Mt Inf: 181.6 Mt	Cougar Pit Expansion (CPX) approved (2016); exploration drilling in expansion areas; coal quality testing; P+Pr reserves are projected to support another 31 years of mining at the current planned production rates.
Line Creek	Southeast	Teck Coal Limited	HCC, TC	3.8 Mt clean	HCC P: 2.1 Mt Pr: 61.5 Mt TC P: 0.5 Mt Pr: 9.4 Mt	HCC M: 312.1 Mt I: 410.5 Mt Inf: 397.1 Mt TC M: 3.7 Mt I: 3.2 Mt Inf: 1.7 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	Approx. 200,000 t clean coal	na	na	Resources and reserves are unpublished. Resumed operations Sept. 2017. Exploration 2017-2018.

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

At the **Mount Polley** mine, Imperial Metals Corporation suspended operations from May to August because of a labour disruption, and mill feed came from low-grade stockpiles. The 2018 production target is 15.6 Mlb Cu and 39,500 oz Au, about 87% of the target set earlier in the year. On January 7th, 2019 Imperial announced that operations would be suspended due to declining copper prices. Milling of low-grade stockpiles would continue until the end of May.

New Gold Inc. reported production to the end of the 3rd quarter for **New Afton** totalling 64.3 Mlb of Cu, 58,551 oz Au and 200,000 oz Ag from 3.973 Mt of ore grading 0.88% Cu and 0.54 g/t Au. Metal recoveries averaged 83.3% for Cu and 84.8% for Au.

3.2. Coal mines

Nine operating coal mines (Table 3) accounted for a forecast production of \$6.31 billion for 2018. 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. Conuma's **Willow Creek** mine restarted in July.

The average prices for the year (as of mid-November 2018) were US\$186 for hard coking coal and US\$149 for PCI coal, up slightly from 2017.

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 \$443 million (4.0% of total mineral production) and for aggregates of \$349 million (3.0% 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 2018, only Centerra Gold Inc.'s **Kemess Underground** project (Table 5) was considered under development, albeit at the earliest stages.

4.1. Kemess Underground (Centerra Gold Inc.)

The **Kemess Underground** project (KUG) is a calc-alkaline porphyry Cu-Au-Ag deposit in the North Central Region. In a technical report issued in July 2017, KUG was estimated to contain 246.4 Mt of Indicated resource containing 1.195 Mlbs of Cu, 3.3 Moz of Au, and 13.9 Moz of Ag. Within this resource are Probable reserves of 107.4 Mt containing 629.6 Mlbs of Cu, 1.9 Moz of Au and 6.7 Moz of Ag. In July 2018, a Mines Act permit for KUG was issued and, by the end of September, the North Tunnel portal was completed. Excavation was underway at the South Portal entrance and a nearby staging area was nearly complete, with the adit itself to be started in early 2019. Mine startup is anticipated in about 2022. During construction the project will provide about 575 jobs, dropping to about 475 with the start of mining operations.

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 (Table 6) discussed below are grouped by region.

5.1. Northwest Region

5.1.1. Proposed metal mines

Gavin Mines Inc. continues to work towards restarting the historic **Dome Mountain** gold and silver mine. The project has current Mines Act and Environmental Management Act permits in good standing and is allowed to mine up to 75,000 tpy. In early 2013, the project submitted applications to amend existing permits, which would allow for onsite milling and tailings storage. Due to various delays, including regulatory changes arising from the 2014 Mount Polley tailings breach, the permit amendments remain outstanding. Since 2016, stockpiled ore has been processed intermittently at the Nicola Mining Inc. custom mill near Merritt.

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 Mining Corporation. Newmont purchased 50% interest from Novagold Resources Inc. in July. 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 percent 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 65.02 g/t Ag.

Mine	Region	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2018 Production (based on Q1-Q3)	Reserves	Resource	Comments
Burning Daylight	Northwest	Stone Ridge Quarries Ltd.	Columnar basalt; dimension stone	unknown	na	na	Basalt quarrying.
Cassiar Jade	Northwest	Dynasty Jade Ltd.	Nephrite jade; gems and semi- precious stones; 104P 005	unknown	na	na	Trenching, quarrying, placer production.
Dean Kutcho	Northwest	Cassiar Jade Contracting Inc.	Nephrite jade; gems and semiprecious stones; 104I 078	unknown	na	na	Mining.
Jade Valley	Northwest	United Oriental Mining Ltd.	Nephrite jade; gems and semi- precious stones; 104I 048	unknown	na	na	Trenching, quarrying, placer production.
Kalum	Northwest	Kalum Quarry Ltd. Partnership	Industrial rock; crushed rock	unknown	na	na	Drilling, blasting, crushing, production for CN railway bed.
Kutcho Creek Jade	Northwest	Continental Jade Ltd.	Nephrite jade; gems and semi- precious stones; 104I 078	unknown	na	na	Mining, trenching.
Letain	Northwest	Cassiar Jade Contracting Inc.	Nephrite jade; gems and semi- precious stones; 104I 079	unknown	na	na	Mining, trenching.
Polar Jade	Northwest	Glenpark Enterprises Ltd.	Nephrite jade; gems and semi- precious stones; 104I 092	unknown	na	na	Mining, trenching.
Provencher	Northwest	Glenpark Enterprises Ltd.	Nephrite jade; gems and semi- precious stones; 1041 092	unknown	na	na	Mining, trenching.
Wolverine	Northwest	Cassiar Jade Contracting Inc.	Nephrite jade; gems and semi- precious stones	unknown	na	na	Mining, trenching.
Fireside	Northeast	Fireside Minerals Ltd.	Barite; vein barite; 094M 003, 19	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.

Table 4. Selected operating industria	l mineral mines and quarries	s, 2018, forecast mine	production, reserves,	and resources.
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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.
Kettle Valley quarries	South Central	Kelowna Sand and Gravel Ltd./Kettle Valley Stone Company	Ashlar, flagstone, thin veneer; 082ENW109, 111, 112	na	na	na	
Z-1	South Central	ZMM Canada Minerals Corp.	Zeolite; open system zeolites; 092INW095	9000 t	na	Approx. 800,000 t	Historical resource.
4J	Southeast	Georgia- Pacific Canada Limited	Gypsum; evaporitic bedded gypsum; 082JSW009	na; Processing stockpiled ore	na	Estimated 20 Mt	Processing stockpiles; updating mine expansion plans.
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).
Grand Forks Slag	Southeast	Granby River Mining Company Inc.	Slag/silica; tailings from Grand Forks smelter dumps; 082ESE264	Quarrying for abrasives and roofing granules	na	na	Crushing, screening, environmental monitoring.
Horse Creek Silica	Southeast	HiTest Sand Inc. (PacWest Silicon)	Silica, industrial use, aggregate; 082N 043	na	na	Estimated: 3 Mt at 99.5% Silica (1987)	Variety of aggregate and industrial use products; initial phases of public consultation for a silicon metal smelter in Newport, WA, USA.

Moberly Silica	Southeast	HCA Mountain Minerals Limited (Northern Silica Corp.)	Silica; industrial use silica, frac sand; 082N001	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)	Updated mine design and haul roads; geological modelling to upgrade the resource; operation redeveloped for frac sand, and processing plant commissioned in 2017 (300,000 tpy capacity); Phase II expansion to 600,000 tpy will cost an additional USD \$15M.
Mount Brussilof	Southeast	Baymag Inc.	Magnesite; hydrothermal sparry magnesite; 082JNW001	230,000 t	P: 50 Mt	na	Exploration drilling at Struna Creek project (650 m, 6 DDH); 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.
Apple Bay (PEM 100)	Southwest	Linceo Media Group Inc.	Silica+alumina; Volcanic glass- perlite; 092L 150	na	na	na	Care and maintenance 2018.
Garibaldi Pumice	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.
Sumas Shale	Southwest	Sumas Shale Ltd. (Lafarge Canada Inc., Clayburn Industrial Group)	Shale, clay, sandstone; residual kaolin; 092GSE024	About 500,000 t annually	na	50+ years	Approximately 55% shale, 45% sandstone for cement production.
Texada Quarry	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.

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

Table	5.	Mine	devel	opment	projects.
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Project	Region	Operator (partner)	Commodity; deposit type; MINFILE	Reserves	Resource	Comments
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 285.6 Kt (629.6 Mlbs) Cu, 58.1 t (1.87 Moz) Au, 214 t (6.88 Moz) Ag	I: 246.4 Mt at 0.22% Cu, 0.42 g/t Au, 1.75 g/t Ag containing 542.2 Kt (1195 Mlbs) Cu, 103 t (3.33 Moz) Au, 431.3 t (13.87 Moz) Ag; inclusive of reserves	Mine permit approved July 2018. Mine start-up estimated for 2022. Proposed underground panel cave mine with 24,600 tpd ore processing rate and life- of-mine average annual production of 3.30 t (106,000 oz) Au and 21 Kt (47 Mlbs) Cu over a 12-year mine life.

Pr = Probable; I = Indicated

Table 6. Selected proposed mine projects.

Project	Region	Operator (partner)	Commodity; deposit type; MINFILE	Reserves	Resource	Comments
Dome Mountain	Northwest	Dome Mountain Resources of Canada Inc.	Au, Ag; vein breccia and stockwork; 093L 022	na	na	Permit amendments outstanding. Stockpiled ore intermittently processed at Nicola Mining Inc. mill near Merritt.
Galore Creek	Northwest	Galore Creek Mining Corp. (50% Teck Resources Limited, 50% Newmont Mining Corporation)	Au, Cu; alkalic porphyry; 104G 090	P+Pr: 528 Mt at 0.59% Cu, 0.32 g/t Au, 6.02 g/t Ag	M+I: 286.7 Mt at 0.33% Cu, 0.27 g/t Au, 3.64 g/t Ag. Resources exclusive of reserves	Baseline monitoring. Newmont purchased 50% interest from Novagold Resources Inc. in July. Multi-year prefeasibility study announced, with an annual budget of \$10 to \$15 million (50% basis).
KSM	Northwest	Seabridge Gold Inc.	Au, Cu, Ag, Mo; calc-alkalic porphyry; 104B 191	P+Pr: 2.198 Bt at 0.55 g/t Au, 0.21% Cu, 2.6 /t Ag, 0.00426% Mo	M+I: 2.925 Bt at 0.52 g/t Au, 0.21% Cu, 2.7 g/t Ag, 0.0055% Mo. Resources include mineral reserves	Results from 2018 drilling at the Iron Cap deposit extended its high- grade core down plunge and will be used for an upgraded resource estimate. Highlight results included 548 m of 0.63 g/t Au and 0.44% Cu.
Morrison	Northwest	Pacific Booker Minerals Inc.	Cu, Mo; calc-alkalic porphyry; 093M 007	P+Pr: 224.25 Mt at 0.33% Cu, 0.163 g/t Au, 0.004% Mo	na	Baseline monitoring, EA ongoing. Resource information from company website.
Red Mountain	Northwest	IDM Mining Ltd.	Au, Ag; porphyry related gold; 103P 086	na	M+I: 2.771 Mt at 7.91 g/t Au, 22.75 g/t Ag	Diamond drilling (40 hole, 10,000 m). Announced an updated M+I resource estimate. Granted a provincial environmental assessment certificate; federal certificate anticipated in early 2019.

Murray River	Northeast	HD Mining International Ltd.	Coal; bituminous; 0931 035	P: 261.6 Mt mineable	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.
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% 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 niobium over a 24-year mine life. In 2018, completed 24 boreholes, 2700 m total for metallurgical testing.
Blackwater	North Central	New Gold Inc.	Au, Ag; epithermal Au-Ag-Cu (intermediate sulphidation); 093F 037	P: 124.5 Mt at 0.95 g/t Au, 5.5 g/t Ag, containing 3.79 Moz Au, 22.1 Moz Ag Pr: 169.7 Mt at 0.68 g/t Au, 4.1 g/t Ag, containing 3.73 Moz Au, 22.3 Moz Ag	M: 117 Mt at 1.04 g/t Au, 5.6 g/t Ag containing 3.90 Moz Au, 21.06 Moz Ag I: 189 Mt at 0.78 g/t Au, 6.0 g/t Ag, containing 4.73 Moz Au, 36.47 Moz Ag, additional to reserves	Environmental Assessment (under review), engineering and environmental studies. Proposed open-pit mine with 60,000 tpd ore processing rate and life-of-mine average annual production of 12.8 t (413 Koz) Au and 54.2 t (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.
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+Inf: 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.

Harper Creek	South Central	Yellowhead Mining Inc.	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 offer to buy Yellowhead Mining late 2018.
New Prosperity	South Central	Taseko Mines Ltd.	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 2018 but a BC Supreme court decision declaring a work permit valid, was appealed. Pending the appeal, an injunction preventing work is in place.
Ruddock Creek	South Central	Ruddock Creek Mining Corporation (Imperial Metals 50%, Mitsui Mining and Smelting Co. 30%, ITOCHU Corp. 20%)	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 2018. 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) 306.5 Mt grading 0.39 g/t Au, 0.64 g/t Ag Inf: 450.64 Mt 0.28 g/t Au, 0.61 g/t Ag	Project at environmental assessment pre-application stage. Exploration in 2018 included drilling.
Bingay Main	Southeast	Centermount Coal Ltd.	Coal (HCC); open pit and underground; 082JSE011	na	M: 42.43 Mt I: 52.9 Mt (2012)	Pre-application of EA (2012); resubmitted project description (2017); 13 Mt; 15-year mine life; 1 Mt/y.
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; updated resources; working on Preliminary Economic Assessment.
Coal Mountain Phase II (Marten Wheeler)	Southeast	Teck Coal Limited	Coal (PCI and TC); open pit and underground; 082GNE006	na	HCC: M+I: 173.9 Mt Inf: 7.9 Mt PCI: M+I: 6.5 Mt Inf: 0.9 Mt (2015)	Pre-application of EA (2014); potential of 76.5 Mt; 34-year mine life; 2.25 Mtpy; EA withdrawn in late 2015; project on hold.

Crown Mountain	Southeast	NWP Coal Canada Ltd. (Jameson Resources Limited 92%, Bathurst Resources Limited 8%)	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 for 8% with ability to earn 50% with investment of \$121.5 M; drilling (4200 m, 23 holes); pre-application of EA (2014); Application Information Requirements (AIR) received in April (2018); coal quality testwork; water quality and treatment studies involving passive biological treatment; engineering studies and mine design; 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.
Kootenay West	Southeast	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; 400,000 tpy; 43-year mine life; blended product to market specifications.
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)	Drilling (5000 m, 23 holes); environmental and baseline work; drilling of 23 groundwater monitoring wells; 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; crushed rock; na	na	na	Orca environmental certificate amendment Application Information Requirements approved for proposed 250,000 tpy near the Orca quarry.

Provincial Overview of Exploration and Mining in British Columbia, 2018. British Columbia Geological Survey, Information Circular 2019-01

BURNCO Aggregate	Southwest	BURNCO Rock Products Ltd.	Aggregate; sand and gravel; na	na	Approx. 20 Mt	Has environmental certification.
Sechelt Carbonate	Southwest	Ballinteer Management Inc.	Limestone, dolostone, aggregate; dolomite, 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

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. Seabridge received federal and provincial approval of its environmental assessment in 2014 and is seeking partnership to enter construction. In 2018, Seabridge continued to drill the Iron Cap deposit. Results extended its high-grade core down plunge and will be used to produce an upgraded resource estimate. KSM economics might be improved if the Iron Cap deposit is mined before the Kerr deposit. 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 2.924 Bt grading 0.52 g/t Au, 0.21% Cu, 2.7 g/t Ag and 55 ppm Mo.

Pacific Booker Minerals Inc.'s **Morrison** porphyry Cu-Au-Mo-Ag project has Measured plus Indicated resources reported as 208.3 Mt at 0.39% Cu, 0.19 g/t Au, 0.005% Mo (at a 0.30% Cu Eq cut-off). After the Mount Polly tailings breach in 2014, the Morrison environmental assessment review was suspended, but it resumed in June 2015. In July 2015, a letter from the British Columbia Minister of Environment and Minister of Energy and Mines stated that project design concerns remained. In 2018, Pacific Booker continued to lobby for the project.

The **Red Mountain** project is a proposed high-grade underground gold mine. In 2018, IDM Mining Ltd., carried out a 40-hole, 10,000 m diamond drilling program and announced an updated Measured plus Indicated resource estimate of 2.77 Mt of 7.91 g/t Au and 22.75 g/t Ag. As well, they were granted their provincial environmental assessment certificate. A federal certificate is anticipated in early 2019.

5.2. Northeast Region

5.2.1. Proposed coal mines

HD Mining International Limited's **Murray River** project is a proposed underground mine with Proven mineable reserves of 261.6 Mt, and Measured plus Indicated resources of 314.2 Mt. In 2018 the company received its Mines Act permit that would allow operations to begin. The company plans to construct its own wash plant and use existing rail facilities. The project is expected to provide about 764 jobs in direct employment for 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 environmental assessment process was suspended in January 2016, and remains so pending further study on the effects on caribou and water quality.

5.3. North Central Region

5.3.1. Proposed metal mines

Taseko Mine Ltd.'s **Aley** niobium-bearing carbonatite project is a proposed open-pit mine that would process 10,000 tpd to produce ferroniobium. Reserves stand at 84 Mt grading 0.5%Nb₂O₅. The projected mine life is 24 years and environmental assessment is underway. In 2018, Taseko completed 25 drill holes at **Aley**, sited within the perimeter of previous exploration drilling and totalling 2700 m, to collect material for further metallurgical testing.

In 2018, New Gold Inc. continued with the environmental assessment process for its **Blackwater** project. Permitting is coordinated with both federal and provincial governments, with the aim of meeting the requirements for an Environmental Assessment Certificate (EAC) from the Province of British Columbia, and a Decision Statement from the federal Minister of the Environment. In November 2018, the Canadian Environmental Assessment Agency began a 30-day public and indigenous comment period on its draft Environmental Assessment report. New Gold continued collecting baseline data, completed additional soil and till sampling, and undertook geotechnical work related to mine design. Proven and Probable reserves stand at 8.2 Moz of Au, and 60.8 Moz Ag. As proposed, Blackwater would be a 60,000 tpd operation with a 17-year mine life.

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

5.4.1. Proposed metal mines

The **Ajax** copper-gold porphyry project is owned by KGHM Ajax Mining Inc., which is an 80:20 joint venture between KGHM Polska Miedź S.A. (KGHM SA) and Abacus Mining and Exploration Corporation. A revised feasibility study, released at the start of 2016, modelled the project 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. The company has not announced plans for the site.

Avino Silver & Gold Mines Ltd. 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. 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 upgrades and planning to meet permitting requirements.

The **Harper Creek** copper-gold-silver project has Proven and Probable mineral reserves of 716 Mt grading 0.26% Cu, 0.029 g/t Au and 1.2 g/t Ag. A 2104 feasibility study proposed a 70,000 tpd operation with a mine life of 28 years. Initial capital costs would exceed \$1 billion. In December 2018, Taseko Mines Limited announced an agreement whereby it would acquire all of the outstanding common shares of Yellowhead Mining Inc. and acquire the asset. The agreement was expected to close in early 2019.

The New Prosperity gold-copper porphyry project of Taseko Mines Limited has defined 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 November 2013 and has extended its expiry date by five years. In 2017, the British Columbia Ministry of Energy, Mines and Petroleum Resources issued a permit for a detailed site investigation of proposed mine infrastructure. Although a 2018 British Columbia Supreme Court decision would have allowed this work to proceed, opponents of the project have appealed and obtained an injunction preventing the work pending the appeal.

Ruddock Creek Mining Corporation (Imperial Metals Corporation (50%) and joint venture partners Mitsui Mining and Smelting Co. Ltd. (30%) and Itochu Corporation (20%)) own the **Ruddock Creek** zinc-lead project. 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. In 2018, Japan Oil, Gas and Metals National Corporation (JOGMEC) funded Imperial's share of a drill program designed to test for mineralized extensions. By funding the program, JOGMEC earns a right to participate in the project. The project remains in the pre-application phase of environmental assessment.

Spanish Mountain Gold Ltd.'s **Spanish Mountain** gold project has been in the pre-application phase of environmental assessment since 2011. A 2017 updated preliminary economic assessment was based on a 20,000 tpd, 24-year operation focussed on a pit at the First zone. Initial capital expenditure was estimated at \$507 million, pre-tax net present value \$597 million (at 5% discount rate) and initial rate of return 22%. Average gold production would be 92,000 ozpy.

5.5. Southeast Region

5.5.1. Proposed coal mines

Centermount Coal Ltd. proposes an open-pit coal mine for its **Bingay Creek** project. The mine would produce approximately 1 Mty during an estimated 15-year lifespan, with a total resource of approximately 13 Mt of clean coal. The project entered preapplication of environmental assessment in 2013; the company resubmitted the project description in 2017. Environmental baseline studies are ongoing.

In 2015, Teck Coal Limited withdrew from the pre-application phase of environmental assessment for their **Coal Mountain Phase II** (Marten Wheeler) project, and the project remains on hold. The project was designed to replace production at the **Coal Mountain** mine, which suspended mining in Q3 of 2018.

The **Crown Mountain** property is owned by NWP Coal Canada Ltd. (92% Jameson Resources Limited and 8% Bathurst Resources Limited). In April of 2018, application information requirements were issued by the environmental assessment office. The proposed project is 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) and a preliminary prefeasibility study. Bathhurst could become a 50/50 joint venture partner after exercising all tranches in the terms of an agreement, with an investment totalling \$121.5 million.

The **Michel Coal** project of North Coal Limited, a wholly owned subsidiary of CoalMont Pty Ltd., is in the pre-application stage of environmental assessment. The project includes the Loop Ridge, Loop South, Tent Mountain, and Michel Head areas. In September of 2018, a revised project description was submitted. The expanded plan will give them more flexibility in blending product from different areas to client specifications. The project is expected to produce between 2.3 and 4 Mt annually, with a 30-year mine life.

5.5.2. Proposed industrial mineral mines or quarries

Eagle Graphite Corp. operates the **Black Crystal** flake graphite project. In 2018, the company updated the resource estimate with results obtained in their 2016 drilling, and focussed efforts on research and development to upgrade the purity of their product for use in the energy storage industry.

The **Driftwood Creek** project is owned by MGX Minerals Inc. In 2016, a resource estimate reported Measured and Indicated resources of 8.028 Mt grading 43.3% MgO (using a cut-off grade of 42.5% MgO). In 2018, the company continued with environmental baseline studies, carried out drilling and released a Preliminary Economic Assessment for a 1200 tpd quarry. The mine would produce 169,700 t of MgO at an average grade of 43.27% MgO, with a 19-year mine life.

CertainTeed Gypsum Canada Inc. continued to advance their **Kootenay West** project. The project was approved through the Environmental Assessment Office in January 2018, and is currently working to fulfill conditions outlined in the approval. The total mineral reserve is estimated at 18.7 Mt, and the mine would have an average production rate of 400,000 tpy, during a 42-year mine life.

5.6. Southwest Region

5.6.1. Proposed industrial mineral mines or quarries

Polaris Materials Corporation is including the **Black Bear** aggregate 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. owns the property comprising the **Sechelt Carbonate** project. They filed engineering, archeological, and baseline environmental studies for assessment in 2016; no activity was reported for 2017 or 2018. The property contains resources of calcite- and dolomitebearing carbonate rock and gabbroic rock for potential use as aggregate.

6. Exploration expenditures

In 2018, 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 Ernst & Young 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 \$331.4 million for 2018, up \$84.8 million from the 2017 survey total of \$246.6 million. Of this, \$50.2 million was contributed by coal projects and \$281.2 million by metal and industrial mineral projects (Fig. 5). Exploration expenditures by region for 2018 are illustrated in Figure 6. Exploration expenditures can be further divided into fi ve categories: grassroots, early stage, advanced stage, mine evaluation, and mine lease (Figs. 7-13). The provincial combined total result for grassroots and early stage exploration in the 2018 survey is 44.4% up from the 2017 total of 34.7%. The total reported metres drilled for the province was 730,500 up from the 2017 total of 626,897 (see Fig. 14 for regional breakdown).



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



Fig. 6. 2018 exploration expenditures by region.



Fig. 7. Province-wide 2018 exploration expenditures by category.



Fig. 8. Northwest Region 2018 exploration expenditures by category.



Fig. 11. South Central Region 2018 exploration expenditures by category.



Fig. 9. Northeast Region 2018 exploration expenditures by category.



Fig. 12. Southeast Region 2018 exploration expenditures by category.



Fig. 10. North Central Region 2018 exploration expenditures by category.

Fig. 13. Southwest Region 2018 exploration expenditures by category.



Fig. 14. 2018 exploration drilling by region.

7. Exploration land tenure

Acquisition of new mineral claims in 2018 was up compared to 2017 (Fig. 15). The total for 2018 was 1,961,719 hectares vs. 1,613,486 hectares for the previous year. New coal licenses issued in 2018 totalled 8852 hectares, down from the 2017 total of 48,118 hectares (Fig. 16).

8. Selected exploration project highlights

For the second year in a row, the province saw an increase in recorded exploration expenditures. Explorationists 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 an



Fig. 15. New mineral claims by year.



Fig. 16. New coal license issuances by year.

increase in grassroots and early stage projects. Below, selected exploration projects (Fig. 1; Table 7) are grouped by project type and region; the individual regional sections of this volume provide further details.

8.1. Selected precious metal projects 8.1.1. Northwest Region

In 2018, the price of gold sustained interest in gold exploration in the Northwest Region. Since 2016, Brixton has staked claims and completed transactions to secure approximately 1000 km² of mineral rights for the **Atlin Gold** project. In 2018, Brixton conducted geological mapping, rock and chip sampling, and biogeochemical studies, and collected 2500 soil samples across selected areas. Several gold-in-soil anomalies were defined.

The first drill hole of 2018 at the North Boundary zone (NBZ), part of Aben Resources Ltd.'s **Forest Kerr** project, intersected multiple high-grade zones including 38.7 g/t Au over 10.0 m. Subsequent holes also returned high-grade gold assays. The company also discovered a new mineralized zone (South Boundary zone), about 1.5 km south of the NBZ. Drilling intersected quartz veins with abundant pyrite and chalcopyrite and returned anomalous Au, Ag and Cu assays.

In 2018, Metallis Resources Inc. carried out the first ever drill programs at the Cole and Nina targets of the **Kirkham** project. Although these were porphyry Cu-Au targets, drilling at Cole intersected an intrusion-related massive sulphide pyrite-pyrrhotite vein that assayed 11.18 g/t Au over 7.7 m.

At their **Premier/Dilworth** project, Ascot Resources Ltd. drilled an additional 45,800 m in 2018, following up on 140,000 m of drilling in 2017. Reported results included 20.0 m of 8.04 g/t Au and 21.4 g/t Ag at the western extension of Premier, 7.2 m of 20.67 g/t Au and 24.92 g/t Ag at the Big Missouri zone, and 12.38 m of 8.91g/t Au and 22.9 g/t Ag at the North Star prospect. In December, the company released an updated resources estimate. For the Premier/Northern Lights, Big Missouri, Silver Coin and Martha Ellen deposits, total Indicated resources are 2.78 Mt grading 7.46 g/t Au and 26.2 g/t Ag. For the Premier/Northern Lights, Big Missouri, Silver Coin and Dilworth deposits, Inferred resources are 6.03 Mt grading 7.18 g/t Au and 24.0 g/t Ag.

Decade Resources Ltd. (65%) and Mountain Boy Minerals Ltd. (35%) carried out a 53-hole 11,000 m diamond drilling program on their **Red Cliff** project. Drilling results for the Waterpump zone included 4.54 m of 12.11 g/t Au and 7.26 m of 10.6 g/t Au.

Skeena Resources Ltd. continued with underground and surface drilling at their past-producing **Snip** gold mine project, completing 7732 m in 46 holes. Results included 13.8 g/t Au over 18.0 m. In October, it was announced that Skeena granted Hochschild Mining Holdings Limited (a wholly owned subsidiary of Hochschild Mining plc) an option to acquire 60% of the project.

In 2018, GT Gold Corp. extended Saddle South gold-silver mineralized zones along strike and identified additional highgrade gold mineralization at depth for their **Tatogga** project.
 Table 7. Selected exploration projects.

Project	Region	Operator (partner)	Commodity; deposit type; MINFILE	Resource (NI 43- 101 compliant unless indicated otherwise)	Comments
Atlin Gold Project	Northwest	Brixton Metals Corporation	Au; precious metal veins	na	Geological mapping, rock and chip sampling, biogeochemical studies, and 2500 soil samples. Several gold-in-soil anomalies.
Brucejack Regional	Northwest	Pretium Resources Inc.	Au, Ag; epithermal vein	na	Evaluation of 1250 km ² of mineral claims surrounding the mine area. Diamond drilling (8000 m), mapping and prospecting. At the American Creek zone, drilling highlight results included 1.5 m grading 10.15 g/t Au and 25.5 m grading 41.54 g/t Ag, 2.12% Zn and 0.56% Pb. Prospecting sample results located the new Upper Kirkham zone. Samples assayed as high as 3.55 g/t Au, greater than 10,000 g/t Ag, 4.7% Cu, greater than 20% Pb and 3.8% Zn.
Clone	Northwest	Sunvest Minerals Corp.	Au, Ag, Cu, Co; Au, precious metal veins; 103P 251	na	Geochemical rock, silt and soil sampling, detailed geological mapping and packsack drilling. A number of samples returned anomalous Cu, Ag and Au assays. A newly discovered mineralized vein returned a 1 m chip sample result of 4.11% Cu, 160 g/t Ag, 0.52 g/t Au.
Dolly Varden	Northwest	Dolly Varden Silver Corporation	Ag, Zn; Noranda/ Kuroko massive sulphide; 103P 188	I: 3.073 Mt at 321.6 g/t Ag Inf: 898,500 t at 373.3 g/t Ag	Drilling, 29,108 m in 84 holes. A new zone, (Bonus) discovered. Results included 15.50 m grading 161.4 g/t Ag, 0.25% Pb and 0.20% Zn. Drilling on known zones included 24.00 m grading 287.5 g/t Ag, 0.29% Pb, and 0.11% Zn at Torbrit East and 29.15 m grading 226.0 g/t Ag, 0.09% Pb, and 0.13% Zn at the Moose-Lamb zone.
Duke	Northwest	Amarc Resources Ltd.	Cu, Mo, Au; porphyry Cu- Au; 093M 009, 121, 163	Historic non NI 43- 101 compliant I: 41 Mt at 0.25% Cu, 0.01% Mo	Property straddles the Northwest and North Central regions. Six diamond drill holes totalling 3600 m completed. Highlight results included 348 m grading 0.23 % Cu, 0.013% Mo, 1.1 g/t Ag, 0.05 g/t Au.
Eskay Creek	Northwest	Skeena Resources Limited	Au, Ag, Zn, Cu, Pb; VMS; 104B 008	I: 1.08 Mt at 4.9 g/t Au, 72 g/t Ag (pit constrained) Inf: 4.26 Mt at 3.3 g/t Au, 72 g/t Ag (pit constrained) I: 2.51 Mt at 7.2 g/t Au, 215 g/t Ag (underground) Inf: 0.81 Mt at 7.2 g/t Au, 214 g/t Ag (underground)	Diamond drilling, compiled and reviewed 20 years of exploration and production information and completed a geologic model and resource estimate. Drilling highlights include 14.55 m grading 7.36 g/t Au, 1189 g/t Ag and 31.50 m grading 10.16 g/t Au, 331 g/t Ag and 42.65 m grading 9.49 g/t Au, 111 g/t Ag.

Forest Kerr	Northwest	Aben Resources Ltd.	Au, Ag, Cu; precious metal veins	na	Diamond drilling, 36 holes totalling 9900 m. Drilling intersected multiple high-grade zones including 38.7 g/t Au over 10.0 m.
Golddigger	Northwest	Goliath Resources Limited	Au, Ag, Pb, Cu; polymetallic veins	na	A 0.55 m channel sample graded 29.70 g/t Au and 14.30 g/t Ag, a 0.50 m chip sample graded 47.50 g/t Au and 272.00 g/t Ag and grab samples graded up to 113.50 g/t Au and 249.00 g/t Ag.
Hank	Northwest	Golden Ridge Resources Ltd.	Au, Cu; calc-alkalic porphyry	na	Drilling discovered new porphyry Cu- Au at the Williams zone. Discovery hole returned 327 m grading 0.31% Cu, 0.35 g/t Au and 1.94 g/t Ag.
Hat	Northwest	Doubleview Capital Corp.	Au, Cu; calc-alkalic porphyry; 104J 015	na	Project optioned to Hudbay Minerals Inc. by Doubleview Capital Corp. In the summer, a 40 line-km, deep-penetrating induced polarization survey was carried out to delineate drilling targets.
Kinskuch (Hecla)	Northwest	Hecla Quebec Inc.	Ag, Cu, Pb, Zn; polymetallic veins	na	Diamond drilling defined silver-enriched base metal mineralization over a strike length of 4.8 km.
Kirkham	Northwest	Metallis Resources Inc.	Au, Cu; calc-alkalic porphyry and Au, Ag; intrusion related; 104B 079	na	Although a porphyry Cu-Au target, drilling at Cole intersected an intrusion- related massive sulphide pyrite-pyrrhotite vein that assayed 11.18 g/t Au over 7.7 m.
KSP	Northwest	Colorado Resources Ltd.	Au, Cu; calc-alkalic porphyry and Au, Ag; intrusion related; 104B 111 and 104B 013	na	Diamond drilling, 7847 m in 35 holes. Results included 32 m grading 0.32 g/t Au and 1.64% Zn and 50 m grading 2.28 g/t Au, including 6 m grading 7.36 g/t Au.
Kutcho	Northwest	Kutcho Copper Corp.	Cu, Pb, Zn, Au, Ag; VMS; 104I 060	M+I: at 16.853 Mt of 1.89% Cu, 2.87% Zn, 0.36 g/t Au and 32.8 g/t Ag (at a 1.0% Cu cut-off)	Results from 2018 drilling included 28 m of 2.09% Cu, 6.1% Zn, 65.8 g/t Ag, 0.82 g/t Au and 5.4 m of 2.48% Cu, 1.0% Zn, 114.0 g/t Ag, 0.24 g/t Au. A bench scale metallurgical study is underway and a feasibility study is scheduled for 2019.
Maroon	Northwest	Gitennes Exploration Inc.	Au, Pb, Zn; polymetallic veins; 103I 029	na	Reconnaissance prospecting found several polymetallic quartz-sulphide veins. Sampling focussed on historical workings and returned results up to 50 g/t Au, 11.5% Zn and 13.9% Pb.

Table	7.	Continued.
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Nickel Mountain	Northwest	Garibaldi Resources Corp.	Ni, Cu, Co, Pt, Pd, Au, Ag; tholeiitic intrusion; 104B 006	na	Diamond drilling (32 holes, 11,573 m). Highlight results for 10 holes include 30.5 m of 3.10% Ni, 1.86% Cu, 0.081% Co, 0.863 g/t Pt, 1.776 g/t Pd, 0.739 g/t Au, 7.3 g/t Ag and 5.6 m of 7.60% Ni, 3.36% Cu, 0.198% Co, 0.668 g/t Pt, 0.814 g/t Pd, 0.466 g/t Au, 9.0 g/t Ag.
Ootsa	Northwest	Surge Copper Corp.	Cu, Au, Ag, Mo; porphyry; 093E 105	I: 67.76 Mt 0.21% Cu, 0.17 g/t Au, 0.015% Mo, 2.01 g/t Ag Inf: 410.88 Mt 0.16% Cu, 0.11 g/t Au, 0.018% Mo, 1.95 g/t Ag	A new copper zone discovered 500 m northeast of the East Seel deposit. Continuous mineralization (202 m) assayed 0.26% Cu, 0.31 g/t Au and 1.32 g/t Ag. A later hole intersected 22 m of 0.5% Cu, 0.10 g/t Au, 17.6 g/t Ag, 0.65% Zn and 0.14% Pb. Drilling between the East Seel and Damascus deposits intersected a new gold zone returning 2 m grading 9.4 g/t Au.
Pitman	Northwest	Casa Minerals Inc.	Au, Ag, Cu, Pb, Zn; polymetallic veins	na	New showings, Golden Dragon and Dragon Tale, discovered in 2018. Rock chip sampling at Golden Dragon returned 0.6 m assaying 574.42 g/t Au, 109 g/t Ag, 0.1% Cu, 1.56% Pb, 0.23% Zn and 0.9 m assaying 268.86 g/t Au, 127 g/t Ag, 0.2% Cu, 2.95% Pb, 0.04% Zn. The Dragon Tale showing returned rock sample assays as high as 231 g/t Ag and 6.15% Zn.
Porter	Northwest	StrikePoint Gold Inc.	Ag, Au, Cu, Zn; polymetallic veins	na	StrikePoint Gold acquired the property from Skeena Resources Limited in July and carried out diamond drilling (4800 m), prospecting, and sampling. Thirty-two samples with assays ranging from trace to 43.6 oz/t Ag, trace to 0.54 oz/t Au and trace Zn to 28.8%. A new mineralized vein was discovered with a 205 m strike length and widths of up to 2 m. Samples graded up to 876 g/t Ag and 10.8 g/t Au.
Premier East	Northwest	Decade Resources Ltd.	Au, Ag, Cu; polymetallic veins	na	Rock sampling returned anomalous values for precious and base metals including one sample that graded 5.72 g/t Au, 716 g/t Ag and 11.60% Cu.
Premier/ Dilworth	Northwest	Ascot Resources Ltd.	Au, Ag; Au in quartz veins; 104B 044	I: 2.78 Mt grading 7.46 g/t Au and 26.2 g/t Ag (Premier/ Northern Lights, Big Missouri, Silver Coin and Martha Ellen deposits) Inf: 6.03 Mt grading 7.18 g/t Au and 24.0 g/t Ag (Premier/ Northern Lights, Big Missouri, Silver Coin, Martha Ellen and Dilworth deposits)	Diamond drilling 45,800 m. Results included 20.0 m of 8.04 g/t Au and 21.4 g/t Ag at the western extension of Premier, 7.2 m of 20.67 g/t Au and 24.92 g/t Ag at the Big Missouri zone, and 12.38 m of 8.91g/t Au and 22.9 g/t Ag at the North Star prospect. In December, an updated resource estimate was released.

Red Cliff	Northwest	Decade Resources Ltd. (65%), (Mountain Boy Minerals Ltd. (35%)	Cu, Au, Ag, Zn; polymetallic veins; 104A 037	na	A 53 hole 11,000 m diamond drilling program carried out. Drilling results for the Waterpump zone included 4.54 m of 12.11 g/t Au and 7.26 m of 10.6 g/t Au.
Schaft Creek	Northwest	Teck Resources Limited (75%), (Copper Fox Metals Inc. (25%)	Cu, Au; calc-alkalic porphyry; 104G 015	1.229 Bt at 0.26% Cu, 0.017% Mo, 0.19 g/t Au, 1.69 g/t Ag	Collection of environmental base line data, ongoing First Nations consultation.
Snip	Northwest	Skeena Resources Limited	Au, Ag; mineralized quartz veins; 104B 250	na	Underground and surface drilling (46 holes, 7732 m). Results included 13.8 g/t Au over 18.00 m. In October, Skeena granted Hochschild Mining Holdings Limited an option to acquire 60% of the project.
Stars	Northwest	ML Gold Corp.	Cu, Au, Ag, Mo; porphyry	na	Reported that drilling at two new targets intersected mineralized porphyry. In February, they announced 204 m assayed 0.45% Cu, 0.045 g/t Au, 1.64 g/t Ag, 0.0048% Mo. In August, they announced 405 m assayed 0.20% Cu, 0.0082% Mo, 0.754 g/t Ag and 24 ppb Au.
Tatogga (Saddle North)	Northwest	GT Gold Corp.	Au, Ag, Cu; porphyry; 104G 432	na	New porphyry Cu-Au-Ag discovery. Initial drilling highlights included 430 m of 0.67 g/t Au, 0.41% Cu and 0.89 g/t Ag. A later hole, approximately 200 m to the northwest, returned 363 m of 1.02 g/t Au, 0.51% Cu and 1.72 g/t Ag in 904 m of 0.51 g/t Au, 0.30% Cu and 0.93 g/t Ag.
Tatogga (Saddle South)	Northwest	GT Gold Corp.	Au, Ag, Cu; epithermal Au-Ag, low sulphidation; 104G 433	na	Gold-silver mineralized zones were extended along strike. Additional high- grade Au mineralization at depth. Drilling highlights included 40.89 m of 9.55 g/t Au.
Tenas	Northwest	Allegiance Coal Limited (80%) (Itochu (20%)	bituminous coal; 093L 156	M: 89.113 Mt I: 42.037 Mt Inf: 33.412 Mt	Drilling program for geotechnical information, installing water monitoring wells and collecting samples for geochemical and coal testing studies. 1400 kg of coal sent for sizing, washability, and comprehensive coal quality analyses and to generate samples for coke oven tests. In November, it was announced that Itochu Corporation of Japan (Itochu) was investing in the project. A definitive feasibility study was expected in early 2019.
Treaty Creek	Northwest	Tudor Gold Corp. (80%), (Teuton Resources Corp. (20%), American Creek Resources Ltd. (20%))	Au, Ag; epithermal high sulphidation; 104B 078	na	Diamond drilling (nine holes, 7200 m) targeting the Copper Belle zone. Highlight results included 121.8 m of 1.04 g/t Au with a high-grade interval of 26.6 g/t Au over 1.5 m.

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Turnagain	Northwest	Giga Metals Corp.	Ni, Co; Alaskan-type; 104I 014	M+I: 865 Mt at 0.21% Ni, 0.013% Co Inf: 976 Mt at 0.2% Ni, 0.013% Co	Diamond drilling (40 holes, 10,835 m) to test new targets, infill, collect metallurgical samples and geotechnical information for pre-feasibility study.
Akie	North Central	Canada Zinc Metals Corp.	Zn, Pb, Ag; sedimentary exhalative Zn-Pb-Ag; 094F 031	Updated 43-101: 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, 12.9 g/t Ag, all at 5% Zn cut-off	5 holes on Sitka extension of Cardiac Creek zone, 2013 m total, 567 samples taken. All holes intersected mineralization. June PEA proposed 18-year mine life, mine production rate 4000 tpd, 25.8 Mt total mined, initial capital cost \$302.3 million.
Decar	North Central	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	Metallurgical study to improve on 2013 results. Announced an updated mineral resource estimate.
Indy	North Central	InZinc Mining Ltd.	Zn, Pb, Ag; sedimentary exhalative Pb-Zn-Ag; 093N 240	na	11 holes total 1271 m. Significant Zn, Pb, Ag intersected.
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	27 line-km IP on Nugget, Hilda South, Oriobn, Kemess South extension targets. Relogged historic core, revised deposit model.
Kwanika	North Central	Kwanika Copper Corp. (65% Serengeti Resources Inc., 35% Daewoo Minerals Canada Corp.)	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	21 holes, 7411 m.
Lawyers	North Central	Benchmark Metals Inc.	Au, Ag, Cu, Zn; epithermal low sulphidation Au-Ag-Cu; 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	30 holes, 4116 m, soil and rock samples, airborne VTEM. Discovered two new zones, Marmot and Phoenix East.
Panorama North	North Central	Atrum Coal Panorama Inc., JOGMEC (Japan Oil, Gas, and Metals National Corporation)	Coal; anthracite; 104A 085, 89	na	8 holes, 1979 m targeting low-S PCI coal.

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Pine Pass	North Central	Ethos Gold Corp.	V; sediment- hosted; 093O 009	na	Trenching, sampling. Best result 0.45% V_2O_5 over 20 m.
Stardust	North Central	Sun Metals Corp.	Ag, Pb, Zn; skarn Ag-Pb- Zn; 093N 009	na	22 holes, 6838 m, downhole EM survey. Mapping, prospecting, soil sampling, lidar survey, VTEM/magnetic survey.
Wicheeda	North Central	Spectrum Mining Corporation	Carbonatite- hosted deposits Nb, REE; 093J 014	Inf: non NI 43-101 compliant 11.26 Mt, 2.3% LREE (Ce+La+Nd)	Beginning bulk sample, drilling program.
Axe	South Central	Evrim Exploration Canada Corp. (Antofagasta PLC)	Cu; 092HNE040, 142, 143	I: 39 Mt 0.38% Cu Inf: 32 Mt 0.38% Cu (gold not included)	Mapping, diamond (2113.6 m) and RC (695.3 m) drilling.
Brett	South Central	Ximen Mining Corp.	Au, Ag; epithermal Au- Ag-Cu;,low sulphidation; 082LSW084, 131	na	Metallurgy. A gold recovery batch test of stockpiled material (34 kg) returned a weighted average grade of 4.20 g/t Au.
Cariboo Gold	South Central	Barkerville Gold Mines Ltd.	Au; Au-quartz veins; 093H 140, 139, 19, 6	M+I: 8.1099 Mt 6.1 g/t Au Inf: 12.73 Mt 5.2 g/t Au	Diamond drilling 123,021 m in 439 holes. Updated resource estimate.
Fox	South Central	Happy Creek Minerals Ltd.	W; W skarns; 093A 259, 260, 261, 211	I: 582,000 t 0.826% WO ₃ Inf: 565,400 t 1.231% WO ₃	Geology, geochemistry, updated resource estimate.
Gold Creek	South Central	Kore Mining Ltd.	Au, Ag; Au- quartz veins; 093A 127	na	Diamond drilling 940 m in 4 holes. Highlights included 9.0 m grading 5.8 g/t Au including 1.5 m grading 32.2 g/t Au.
Ike	South Central	Amarc Resources Ltd. (Hudbay Minerals Inc.)	Cu, Mo; porphyry Cu±Mo±Au; 092O 025, 67	na	Diamond drilling 3000 m in 5 holes. Results included 138 m grading 0.28% Cu, 0.024% Mo, 2.1 g/t Ag; 222 m grading 0.35% Cu, 0.022% Mo, 2.4 g/t Ag and 147 m grading 0.26% Cu, 0.042% Mo, 1.9 g/t Ag.
Lac La Hache	South Central	Engold Mines Ltd.	Cu, Au, Ag, Fe; 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 (5000 m, 10 holes), geophysics, geochemistry. Highlight intersections include 8.8 m grading 3.26% Cu, 0.88 g/t Au, 16.88 g/t Ag, 26.7% Fe at Spout North; 31 m grading 1.14% Cu 0.28 g/t Au, 6.89 g/t Ag, 24.31% Fe at G1 and 58.5 m grading 0.47% Cu, 0.06 g/t Au, 2.18 g/t Ag, 6.07% Fe at Gap.

Little Gem	South Central	Blackstone Minerals Ltd.	Co, Au; five- element veins Ni-Co-As- Ag+/-(Bi, U); 092JNE068, 108	na	Diamond drilling (2918 m, 10 holes), geophysics, geochemistry, geology. Initial drill results included 4.3 m grading 1.0% Co and 15 g/t Au and 3.2 m grading 0.8% Co and 4 g/t Au.
Miner Mountain	South Central	Sego Resources Inc.	Cu, Au; alkalic porphyry Cu-Au; 092HSE203, 78	na	Diamond drilling (3000 m, 9 holes), mapping. Drilling highlights include 57 m grading 0.26% Cu and 18 m grading 0.56% Cu.
New Craigmont	South Central	Nicola Mining Inc.	Cu, Au; Cu skarns; 092ISE035	na	Drilling (RC 1250 m, 66 holes, DD 5000 m 18 holes). Drilling results included 73.6 m grading 1.05% Cu and 100.6 m grading 1.33% Cu.
Rabbit North	South Central	Tower Resources Ltd.	Cu, Au; alkalic porphyry Cu-Au; 092INE147, 45		Diamond drilling: 790 m in 2 holes. Highlights include 53 m grading 0.32% Cu and 0.22 g/t Au within a larger interval of 288 m grading 0.18% Cu and 0.12 g/t Au.
Shovelnose	South Central	Westhaven Ventures Inc.	Au; epithermal Au-Ag-Cu, low sulphidation; 092HNE309, 308	na	Diamond drilling (5721 m in 16 holes), airborne and ground geophysics. A new discovery was made with results including 17.77 m grading 24.50 g/t Au.
Duncan	Southeast	Rokmaster Resources Ltd.	Zn-Pb-Ag; carbonate- hosted; 082KSE023, 22	na	Mapping; sampling; soil geochemistry; grab sample results up to 23 g/t Ag, 12.5% Pb, and 21.4% Zn; drill permits received late in 2018.
Elko	Southeast	Pacific American Coal Limited	Coal (HCC, PCI); 082GSE029	M: 19.2 Mt I: 57 Mt Inf: 181.3 Mt (JORC 2015)	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	One tonne sample sent for metallurgical test work; results indicated suitability for medium quality feedstock for metallurgical-grade silicon; sampled 97.8 to 99.9% SiO ₂ ; began drilling late in the year (8 DDH).
Gold Drop	Southeast	GGX Gold Corp.	Au; alkalic intrusion- associated Au; 082ESE055, 150, 152, 153, 285, 286, 287	na	Rock sampling; trenching; channel sampling; drilling at the C.O.D. (71 DDH, 14,500 m); drill results include: 2.05 m grading 50.1 g/t Au; 1.47 m grading 54.9 g/t Au; and 16.03 m grading 4.59 g/t Au; trenching at the Everest, Gold Drop, Silent Friend, and Ken veins.

Greenwood (Lexington/ Golden Crown)	Southeast	Golden Dawn Minerals Inc.	Au-Ag-Pb- Zn+/-Cu; Cu- Au-Ag skarns, polymetallic veins, epithermal Au- veins, porphyry; 082ESE041, 42, 32, 45, 20, 130, 116	Golden Crown: M+I: 163,000 t grading 11.09 g/t Au, 0.56% Cu (2016) Lexington: M+I: 372,000 t grading 6.4 g/t Au, 1.05% Cu (2016)	Golden Crown drilling (33 DDH, 3121 m); drill intersections include 1.74 m grading 11.11 g/t Au, 0.23% Cu, 7 g/t Ag; 1.66 m grading 15.20 g/t Au, 1.37% Cu, and 20.1 g/t Ag; 12.3 m grading 3.53 g/t Au, 0.11% Cu; and 6.95 m grading 6.77 g/t Au, 1.18% Cu; surface mapping and sampling. Lexington dewatering and rehabilitation of underground; mapping; rock sampling; results included: 3.9 m grading 13.41 g/t Au, 2.08% Cu; 2.3 m grading 26.67 g/t Au, 1.77% Cu; 1.8 m grading 30.18 g/t Au, 4.93% Cu; 1.4 m grading 22.2 g/t Au, 4.32% Cu; and 2.6 m grading 17.04 g/t Au, 3.42% Cu; surface mapping and sampling.
Kena	Southeast	Prize Mining Corp. (Apex Resources Inc.)	Au-Cu+/- Pb-Zn-Ag; porphyry, Au-veins, polymetallic veins; 082FSW379, 173, 174, 175, 294	Kena: I: 24.89 Mt grading 0.6 g/t Au; Inf: 85.79 Mt grading 0.48 g/t Au	Released results of 2017 drilling (3425 m, 29 DDH); results include Daylight : 0.9 m grading 62.7 g/t Au, 0.5 m grading 20.9 g/t Au, 0.5 m grading 7.36 g/t Au; Toughnut : 0.7 m grading 7.3 g/t, 1.0 m grading 25 g/t Au, and 2.0 m grading 5.58 g/t Au. 2018 drilling (3386 m, 20 DDH) at Toughnut; results include 4.37 g/t Au over 6.0 m and 14.3 g/t Au over 0.84 m.
Koot	Southeast	MGX Minerals Inc.	Si; silica sandstone; 082JSW025	na	Mapping, sampling, drilling (782 m, 10 DDH); 97.61 to 99.9% SiO ₂ .
LH	Southeast	Magnum Goldcorp Inc.	Cu-Ag-Au; subvolcanic, skarn, Au-veins; 082FNW212	na	Drone-survey magnetics; released 2017 drill results including 8.5 m grading 7.10 g/t Au; gold mineralization appears to be associated with pyrrhotite+/- arsenopyrite; drone magnetic survey and orthophotos.
Sheep Creek	Southeast	Margaux Resources Ltd.	Au+/-Ag, Pb, Zn; Au- quartz veins, polymetallic veins; 082FSW040, 48, 50, 51, 52, 53, 082FSE030, 31, 34, 25	na	Bayonne : mapping; drilling (3308 m, 13 DDH); drill intersections of 1.40 m grading 39.43 g/t Au, and 131.2 g/t Ag; 0.88 m grading 16.88 g/t Au, and 60.2 g/t Ag; and 1.14 m grading 10.85 g/t Au, 23.7 g/t Ag; drilling targeted areas below historic mining and step-out. Sheep Creek : mapping; sampling; compilation of historic data into 3D model using lidar acquired in 2017; sampling of historic grades of 19.2 g/t Au); dump samples sent to research facility to test ore sorting method.

Thor	Southeast	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, 0.51% Pb, and 3.51% Zn Inf: 424,000 t grading 0.98 g/t Au, 176 g/t Ag, 0.14% Cu, 2.26% Pb and 3.2% Zn (2013)	Drilling (1983 m; 30 DDH); downhole magnetics; ground geophysics, including resistivity, magnetics, and VLF; processed a 600 t sample using a pilot test mill, with recoveries of ~25.3% of the Au; extension of SIF gold zone.
Tungsten Tailings	Southeast	Margaux Resources Ltd.	W; tailings; 082FSW010, 9	Estimated: 1.4 Mt grading 0.11% WO ₃ (non- compliant)	Evaluating economic viability to reprocess tailings from historic Emerald mine; 3500 kg sample sent to CRONIMET for testing; 84 samples tested 0.11% WO ₃ ; environmental baseline studies; permitting for 10,000 t bulk sample.
Vine	Southeast	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; non-compliant)	Drilling (6000 m; 15 DDH); magnetotelluric survey; geophysical and geological modeling; focus on East gravity anomaly; infilled gravity survey grid; detailed geophysical and geological model; drilling intersected sulphides (pyrite, pyrrhotite, sphalerite) near Moyie fault zone.
Jasper	Southwest	Nitinat Minerals Corporation	Cu, Zn, Au, Ag; Noranda/ Kuroko massive sulphide; 092C 080, 37, 81, 88	na	Geophysical interpretation.
Ladner Gold	Southwest	New Carolin Gold Corp.	Au, Ag; Au- quartz veins; 092HNW003, 7, 18, 092HSW034	Carolin Inf: 12,352,124 t 1.53 g/t Au McMaster Inf: 3,575,000 t 0.69 g/t Au Tailings I: 445,378 t 1.83 g/t Au Inf: 93,304 t 1.85 g/t Au	Drilling; planned 3400 m underground.

Table 7.	Continued.
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Pemberton Hills	Southwest	Northisle Copper and Gold Inc. (Freeport- McMoRan Mineral Properties Canada Inc.)	Cu, Mo; porphyry Cu ±Mo±Au; 092L 131, 308	na	Drilling 3400 m in 6 holes. IP, geochemistry.
Surespan Gold	Southwest	640895 B.C. Ltd.	Au, Ag; Au- quartz veins; 092L 008, 311, 155	Privateer historical: 122,475 t 17 g/t Au	Drilling 6700 m in 34 holes.

M = Measured; I = Indicated; Inf = Inferred

Drilling highlights included 40.89 m of 9.55 g/t Au. Saddle South, discovered in 2017, is the project's first high-grade epithermal vein occurrence.

Tudor Gold Corp. (80%) and Teuton Resources Corp. (20%) drilled 7200 m in nine holes at their **Treaty Creek** project. The target was the Copper Belle zone and highlight results included 121.8 m of 1.04 g/t Au with a high-grade interval of 26.6 g/t Au over 1.5 m.

8.1.2. North Central Region

In 2018, Benchmark Metals Inc. completed a 30 hole, 4116 m exploration drilling program at their **Lawyers** project. The company also relogged and sent for assay 1051 m of historic mineralized core, collected 1041 soil and 312 rock samples for assay, and completed an airborne VTEM survey. Highlight results from new core include 4.36 m at 6.15 g/t Au and 124.37 g/t Ag and 3.05 m at 5.62 g/t Au and 292.31 g/t Ag. The company plans a large-scale drilling program for 2019, targeting the Marmot occurrence. A 2016 technical report posted an Inferred resource for the Cliff Creek North zone of 550,000 t at 4.51 g/t of Au and 2019.15 g/t of Ag, and for the Duke's Ridge zone of 58,000 t at 4.30 g/t of Au and 139.13 g/t of Ag, both with a 4.0 g/t AuEq cutoff.

8.1.3. South Central Region

Ximen Mining Corp. completed a gold recovery batch test of stockpiled material for their **Brett** project. The sample (34 kg) returned a weighted average grade of 4.20 g/t Au. They are working toward permitting of underground work, starting with re-opening a portal.

Barkerville Gold's multi-target **Cariboo Gold** project was the largest in the region, as it has been for several years. The project included 123,000 m of drilling in 439 holes and an updated resource estimate with 1.6 Moz Au in the Measured and Indicated categories and more than 2 Moz Inferred. They described orogenic gold mineralization, both vein and replacement.

Kore Mining Ltd. carried out 940 m of diamond drilling (four

holes) at the Camp zone on their **Gold Creek** property; assays included 9.0 m grading 5.8 g/t Au including 1.5 m grading 32.2 g/t Au.

Westhaven Ventures Inc. completed 16 holes and more than 5000 m of drilling at their **Shovelnose** project. Results of the first 10 holes included 17.77 m grading 24.50 g/t Au in the South zone, a 2018 discovery. The 2018 intersections are the first to confirm high grade at depth. Follow up drilling at the end of the year tested vertical and strike extents of the vein system. In addition to drilling, Westhaven conducted a ground magnetic survey and passive seismic survey. The South zone target originally appeared as a linear magnetic low in 2017. The seismic survey was to estimate overburden thickness in targets areas. Following results at **Shovelnose**, a subsidiary of Sable Resources Ltd. staked virtually all open ground in the Spences Bridge belt and formed an alliance with Westhaven. Targets are additional mineralized epithermal veins.

8.1.4. Southeast Region

GGX Gold Corp. continued drilling and trenching at their **Gold Drop** property. The property hosts numerous north-trending, easterly dipping gold-bearing veins that are 10 cm to 2 m thick. Drilling (14,500 m, 71 DDH) targeted infill locations and extensions of the C.O.D. and Everest veins. Drill results include 2.05 m grading 50.1 g/t Au; 1.47 m grading 54.9 g/t Au; and 16.03 m grading 4.59 g/t Au. The company also mapped, sampled, and trenched at the Silent Friend and Ken veins, to follow up on grab sample results of 6.98 g/t Au and 38.6 g/t Ag, and 4.47 g/t Au and 23.0 g/t Ag from the historic workings. They also trenched extensions of the Gold Drop vein.

Golden Dawn Minerals Inc. has been evaluating several historic mineralized areas at their **Greenwood** project, including the May Mac, Golden Crown, and Lexington. Drilling that began late in 2017 at Golden Crown (3121 m, 33 DDH), continued in 2018. Drill intersections included: 1.74 m grading 11.11 g/t Au, 0.23% Cu, 7 g/t Ag; 1.66 m grading 15.20 g/t Au, 1.37% Cu, and 20.1 g/t Ag; 12.3 m grading 3.53 g/t Au, 0.11% Cu; and 6.95 m grading 6.77 g/t Au, 1.18% Cu. Surface
mapping and sampling identified mineralization 3 km along strike at the JD zone, with chip sample results ranging between 1.8 and 15.8 g/t Au. At the historic Lexington mine, ventilation was installed and rehabilitation of some of the workings began. Mapping and sampling of underground workings to develop a 3D model and characterize the mineralization was carried out. Rock chip sample results included: 3.9 m grading 13.41 g/t Au, 2.08% Cu; 2.3 m grading 26.67 g/t Au, 1.77% Cu; 1.8 m grading 30.18 g/t Au, 4.93% Cu; 1.4 m grading 22.2 g/t Au, 4.32% Cu; and 2.6 m grading 17.04 g/t Au, 3.42% Cu. Surface mapping and chip sampling along strike west of the underground workings yielded results including 4.5 m grading 14.5 g/t Au.

Magnum Goldcorp Inc. released results from drilling (659 m, 5 DDH) that began in late 2017 for their **LH** property. Intersections included 8.5 m grading 7.10 g/t Au. In 2018, the company expanded magnetic survey coverage and obtained orthophotos using drones.

Margaux Resources Ltd.'s Sheep Creek Gold District project includes the Bayonne and Sheep Creek properties. The company carried out mapping, rock sampling, and drilling on the Bayonne property, which hosts several high-grade, steeply dipping gold-bearing orogenic quartz veins in a granodiorite. Drilling in 2018 (3308 m, 13 DDH) followed up on results from 2017, and focussed on the Main and A veins in areas beneath the historic workings, and step-out areas. Vein intersections included 1.40 m grading 39.43 g/t Au, and 131.2 g/t Ag; 0.88 m grading 16.88 g/t Au, and 60.2 g/t Ag; and 1.14 m grading 10.85 g/t Au, 23.7 g/t Ag. At the Sheep Creek property, Margaux compiled historic data into a 3D model using lidar. Surface workings identified on the lidar survey were used to register the locations of historic workings, and also identified new workings that had no information. The property includes 60 known veins and 34 past producers. Samples from the Reno and Nugget mine dumps were sent for sensor-based sorting testing to determine if waste rock grades could be upgraded and processed. Their planned drill program was delayed due to forest fires until 2019.

8.1.5. Southwest Region

New Caroling Gold Corp.'s **Ladner Gold** project includes the former Carolin mine site. The planned exploration program for 2018 was 3400 m in 28 holes. First-phase drilling on the Main zone included a highlight of 93 m averaging 1.39 g/t Au including 7 m of 5.75 g/t Au. Before recent surface and underground drilling, the company had resource estimates at the past-producing Carolin mine for an open-pit operation of Inferred at 0.5 g/t Au cutoff of 12,352,124 t grading 1.53 g/t Au and for an underground operation of Inferred at 2.0 g/t Au cutoff of 2,588,376 t grading 3.34 g/t Au. The McMaster zone has an Inferred resource of 3,575,000 t grading 0.69 g/t Au at a 0.5 g/t Au cut off. The Carolin mine tailings estimate has 445,378 t at 1.83 g/t Au in the Indicated category and 93,304 t grading 1.85 g/t Au in the Inferred category.

The Surespan Gold project is operated by a numbered

company (640895 B.C. Ltd.), which is privately funded, and results from 6700 m of drilling have not been made public. The area hosted 19 gold producers from the 1930s to the late 1990s, mainly from quartz veins. The Privateer mine was the most productive of these, with 170,463 oz of gold recovered. Between 1934 and 1975, the Zeballos camp produced approximately 300,000 oz gold from veins, mostly at the Privateer and Spud Valley mines. Before recent work that began in 2017, the last significant exploration was in the early 2000s.

8.2. Selected porphyry (Cu-Au, Cu-Mo, Mo) projects 8.2.1. Northwest Region

Amarc Resources Ltd.'s **Duke** property straddles the Northwest and North Central regions. The property includes a porphyry Cu +/-Mo deposit that was the subject of an historic (NI 43-101 non-compliant) inferred resource estimated at 40.8 Mtons at 0.25% Cu and 0.01% Mo. Amarc drilled six holes, totalling 3060 m to follow up on 2017 results. Seven of the eight holes drilled in 2017 and 2018 intersected porphyry Cu-Mo-Ag mineralization. Highlight results from 2018 included 348 m grading 0.23 % Cu, 0.013% Mo, 1.1 g/t Ag, 0.05 g/t Au. Results to date suggest currently defined mineralization is open in all directions.

Golden Ridge Resources Ltd. announced discovering a new porphyry Cu-Au occurrence at the Williams zone of their **Hank** project. The first drill hole intersected 327 m grading 0.31% Cu, 0.35 g/t Au and 1.94 g/t Ag. Additional drilling returned similar grades, and the company expanded induced polarization survey coverage.

The **Hat** project, contains the Lisle alkali porphyry Au-Cu zone. In 2018 Doubleview Capital Corp. optioned the project to Hudbay Minerals Inc. Hudbay will be the operator and has the right to earn up to 65% interest by fulfilling the terms of a threestage agreement, which includes expenditures of \$40 million and costs for a feasibility study. In the summer, a 40 line-km, deep-penetrating induced polarization survey was carried out to target the depth, shape, structure, and dimensions of goldcopper mineralization and to delineate drilling targets.

Surge Copper Corp.'s (formerly Gold Reach Resources Ltd.) **Ootsa** project is adjacent to the past-producing Huckleberry mine and mill complex. In 2018 Surge Copper discovered a new copper zone 500 m northeast of their East Seel deposit. The discovery hole intersected 202 m of continuous mineralization and assayed 0.26% Cu, 0.31 g/t Au and 1.32 g/t Ag. A later hole intersected 22 m of 0.5% Cu, 0.10 g/t Au, 17.6 g/t Ag, 0.65% Zn and 0.14% Pb. Drilling an uplifted fault block between the East Seel and Damascus deposits intersected a new gold zone, returning a 2 m intersection grading 9.4 g/t Au.

The **Schaft Creek** porphyry Cu-Au-Mo is an advancedstage project owned by Teck Resources Limited (75%) and Copper Fox Metals Inc. (25%). In 2018, the companies continued environmental base line studies and First Nations consultations. The project consists of three deposits: the Main (Liard) zone, The Paramount zone and the West Breccia zone. A 2013 feasibility study defined a Proven and Probable reserve of 940.8 Mt grading 0.27% Cu, 0.19 g/t Au, 0.018% Mo and 1.72 g/t Ag. Measured and Indicated resources were listed as 1,228.6 Mt grading 0.26% Cu, 0.017% Mo, 0.19 g/t Au and 1.69 g/t Ag and a 597.2 Mt Inferred resource grading 0.22% Cu, 0.016% Mo, 0.17 g/t Au and 1.65 g/t Ag. Proven and Probable reserves are included within the stated Measured and Indicated resources.

ML Gold Corp. reported that drilling at two new targets on their **Stars** project intersected mineralized porphyry. In February, they announced 204 m assayed 0.45% Cu, 0.045 g/t Au, 1.64 g/t Ag, 0.0048% Mo. In August, they announced 405 m assayed 0.20% Cu, 0.0082% Mo, 0.754 g/t Ag and 24 ppb Au.

GT Gold Corp.'s **Tatogga** project has two target areas, Saddle South and Saddle North. Saddle South is a high-grade gold discovery made in 2017. In 2018, GT Gold reported discovering a new Cu-Au-Ag porphyry at the Saddle North target, approximately 1.5 kilometres east-northeast of the Saddle South gold discovery. Initial drilling highlights included 430 m of 0.67 g/t Au, 0.41% Cu and 0.89 g/t Ag. A later hole, approximately 200 m to the northwest, returned 363 m of 1.02 g/t Au, 0.51% Cu and 1.72 g/t Ag in 904 m of 0.51 g/t Au, 0.30% Cu and 0.93 g/t Ag.

8.2.2. North Central Region

Centerra Gold Inc.'s **Kemess East** project is about 1 km east of the Kemess Underground project. A 2017 report identified an Indicated resource of 113.12 Mt grading 0.38% Cu, 0.46 g/t Au, and 1.94 g/t Ag. In 2018 Centerra carried out 27 line-km of induced-polarization surveys on the Nugget, Hilda South, Oriobn, Kemess South extension targets, relogged historic core and revised their deposit model.

Kwanika Copper Corporation (65% Serengeti Resources Inc., 35% Daewoo Minerals Canada Corp.) was formed in 2017 to continue exploration on the **Kwanika** property. In 2018, the company completed a 21-hole, 7411 m drill program targeting the Central zone. Three of these were to test the foundation characteristics for a potential tailings storage facility. Nine of them were also to be used for ongoing hydrogeological monitoring to support detailed engineering design. The program was part of a new NI 43-101 report expected to be released in mid-2019.

8.2.3. South Central Region

Evrim Resources Corp. and partner Antofagasta Plc. carried out a 3000 m drill program, including diamond drilling and reverse circulation drilling on the **Axe** project.

Hudbay Minerals Inc. (60%) and Amarc Resources Ltd. (40%) drilled five widely spaced holes on the **Ike** project with Amarc as operator. Results included 138 m grading 0.28% Cu, 0.024% Mo, 2.1 g/t Ag; 222 m grading 0.35% Cu, 0.022% Mo, 2.4 g/t Ag and 147 m grading 0.26% Cu, 0.042% Mo, 1.9 g/t Ag. The mineralization remains open.

Sego Resources Inc. had two phases of drilling, with mapping following the first phase, at their **Miner Mountain**

project. Highlights of the first phase include 57 m grading 0.26% Cu and 18 m grading 0.56% Cu. Miner Mountain is an alkalic porphyry Cu prospect with numerous targets in an area of limited exposure about 18 km northeast of the Copper Mountain mine.

Tower Resources Ltd. drilled 760 m in two holes at their **Rabbit North** project in 2018. A highlight was 53 m grading 0.32% Cu and 0.22 g/t Au within a larger interval of 288 m grading 0.18% Cu and 0.12 g/t Au.

8.2.4. Southwest Region

The Pemberton Hills project is divided from Northisle Copper and Gold Inc.'s North Island project as part of an arrangement with Freeport McMoRan (Northisle Copper and Gold Inc. 35%; Freeport-McMoRan Mineral Properties Canada Inc. 65%). The greater property includes several porphyry copper and epithermal gold targets extending along a 40 km west-northwest trend from Island Copper. Hushamu, a porphyry Cu-Mo-Au prospect, is the most advanced, with Indicated 304.4 Mt of 0.21% Cu, 0.29 g/t Au, 0.010% Mo, and 0.56 ppm Re and Inferred 205.6 Mt 0.18% Cu, 0.26 g/t Au, 0.008% Mo and 0.38 ppm Re. In 2015, Northisle Copper and Gold Inc. acquired an option on the Red Dog property, approximately 7.5 km west-north-west of the Hushamu deposit. In 2016, they drilled to verify an historical resource estimate. At a 0.20% Cu cut off, the updated Red Dog estimate has 23.6 Mt at 0.32% Cu, 0.46 g/t Au and 0.007% Mo Indicated and 848,000 t at 0.23% Cu, 0.33 g/t Au and 0.003% Mo Inferred.

Work in 2018 focussed on the earlier stage Pemberton Hills area, under option to Freeport McMoRan. In addition to an IP survey, they drilled 3,400 m in 6 holes. The target is a $1.5 \times 3.5 \text{ km}$ area of advanced argillic alteration. Historically, drilling encountered anomalous copper at depths of about 200 m, suggesting possible blind mineralization.

8.3. Selected polymetallic base and precious metal projects 8.3.1. Northwest Region

Pretium Resources Inc. continued to evaluate their 1250 km² of mineral claims that surround the Brucejack mine. The **Brucejack Regional** project includes the American Creek, Bluffy, and Koopa zones, along with the newly discovered Upper Kirkham zone. The company drilled 8000 m, mapped and prospected. At the American Creek zone, highlight drilling results included 1.5 m grading 10.15 g/t Au and 25.5 m grading 41.54 g/t Ag, 2.12% Zn and 0.56% Pb. Prospecting sample results located the new Upper Kirkham zone. Samples returned assays as high as 3.55 g/t Au, greater than 10,000 g/t Ag, 4.71% Cu, greater than 20% Pb and 3.81% Zn.

At the **Clone Gold** project, Sunvest Minerals Corp. carried out geochemical rock, silt, and soil sampling, and packsack drilling in 2018. Recent ice retreat has resulted in new bedrock exposure and the company carried out detailed geological mapping. Sampling at the Port 19 showing returned Cu values of 0.52%, 0.99%, 1.02% and 1.64% and a Ag assay of 220 g/t. Sampling at the Outbound showing returned multiple rock samples returning in excess of 0.10% Cu (up to 0.56% Cu), and up to 132 g/t Ag, and soil samples with up to 1.04 g/t Au.

At the Clone prospect, sampling returned values including 10.9 g/t Au, and 0.64% Cu in rock samples, and peak values of 1.26 g/t Au and 1.66 g/t Au from soil samples. A new mineralized vein (Southern Glory prospect) was also announced. A quartz vein, up to 1.25 m wide, was mapped along a strike length of about 70 m. Results included a 1 m chip sample returning 4.11% Cu, 160 g/t Ag, 0.52 g/t Au.

Dolly Varden Silver's **Dolly Varden** project consists of the Torbrit, Dolly Varden, Wolf, and North Star deposits and a number of mineralized zones. In 2018, Dolly Varden drilled 29,108 m in 84 holes and discovered a new zone (Bonus). Drilling results included 15.50 m grading 161.4 g/t Ag, 0.25% Pb and 0.20% Zn. Drilling on known zones included 24.0 m grading 287.5 g/t Ag, 0.29% Pb, and 0.11% Zn at Torbrit East and 29.15 m grading 226.0 g/t Ag, 0.09% Pb, and 0.13% Zn at the Moose-Lamb zone.

The **Eskay Creek** project was acquired in late 2017 by Skeena Resources from Barrick Gold Inc. and includes the past-producing Eskay Creek mine. In 2018, Skeena carried out diamond drilling, compiled and reviewed 20 years of exploration and production information, and completed a geologic model and resource estimate. The pit-constrained Indicated resource estimate is 1.08 Mt at 4.9 g/t Au, 72 g/t Ag, and the Inferred resource is 4.26 Mt at 3.3 g/t Au, 72 g/t Ag. The underground Indicated resource is 2.51 Mt at 7.2 g/t Au, 215 g/t Ag, and the underground Inferred resource is 0.81 Mt at 7.2 g/t Au, 214 g/t Ag. Lead, copper, zinc and antimony are potential by-products.

Drilling highlights from 2018 include 14.55 m grading 7.36 g/t Au, 1189 g/t Ag and 31.50 m grading 10.16 g/t Au, 331 g/t Ag and 42.65 m grading 9.49 g/t Au, 111 g/t Ag.

Goliath Resources Limited reported discovering multiple breccias, stockworks, and veins containing high-grade gold and polymetallic mineralization at the **Golddigger** project. A 0.55 m channel sample graded 29.70 g/t Au and 14.30 g/t Ag, a 0.50 m chip sample graded 47.50 g/t Au and 272.00 g/t Ag and grab samples graded up to 113.50 g/t Au and 249.00 g/t Ag. This new gold-enriched polymetallic discovery is in an extensive area where glacier retreat and snow pack loss has increased bedrock exposure.

Hecla Mining Company reported that 2018 drilling at the **Kinskuch** project defined silver-enriched base metal mineralization along a strike length of 4.8 km and that highgrade zones appear to have continuity. These zones may represent two parallel structures or the limbs of a folded body. Although assay results were not mentioned, Hecla reported that they plan to produce a preliminary resource model.

Kutcho Copper Corp.'s **Kutcho** project is at an advanced stage. A preliminary feasibility study from 2017 reported a Probable reserve of 10.4 Mt at 2.01% Cu, 3.19% Zn, 34.61 g/t Ag, and 0.37 g/t Au. At a 1.0% Cu cut off, combined Measured and Indicated resources are estimated at 16.853 Mt of 1.89% Cu, 2.87% Zn, 0.36 g/t Au and 32.8 g/t Ag. In 2018, Kutcho

carried out a comprehensive review of historic data to identify targets for drilling. Results of this drilling included 28 m of 2.09% Cu, 6.1% Zn, 65.8 g/t Ag, 0.82 g/t Au and 5.4 m of 2.48% Cu, 1.0% Zn, 114.0 g/t Ag, 0.24 g/t Au. A bench-scale metallurgical study is underway and a feasibility study is scheduled for 2019.

In 2018, Colorado Resources Ltd. diamond drilled 7847 m in 35 holes at the KSP property. Drilling tested step out targets near the historic Inel basin area, including the Big Rock Deformation zone (BRDZ) to the east, and the Inel zone to the north. Results included 32 m grading 0.32 g/t Au and 1.64% Zn and 50 m grading 2.28 g/t Au, including 6 m grading 7.36 g/t Au.

In 2018, Gitennes Exploration Inc. carried out reconnaissance prospecting and sampling at the **Maroon** project, and found several polymetallic quartz-sulphide veins. Sampling focussed on historical workings and returned results up to 50 g/t Au, 11.5% Zn and 13.9% Pb.

Casa Minerals Inc.'s **Pitman** project includes previously known target areas including Gold Dome and Pitman, and 2018 discoveries, Golden Dragon, Dragon Tale. Rock chip sampling at Golden Dragon returned 0.6 m assaying 574.42 g/t Au, 109 g/t Ag, 0.1% Cu, 1.56% Pb, 0.23% Zn and 0.9 m assaying 268.86 g/t Au, 127 g/t Ag, 0.2% Cu, 2.95% Pb, 0.04% Zn. The Dragon Tale showing is about 1 km from Golden Dragon and rock sampling returned assays as high as 231 g/t Ag and 6.15% Zn.

StrikePoint Gold Inc.'s **Porter** project is within 4 km of Stewart and contains the historic Silverado mine, the historic Handsome Jack workings, the Porter historic resource area, the Big Nunatak showing and the Glacier Creek property. Having acquired the property from Skeena Resources Limited in July, StrikePoint Gold carried out diamond drilling (4800 m), prospecting, and sampling. Glacier retreat has exposed a new mineralized vein along a 275 m strike length near the historic Porter resource. Thirty-two samples were collected, with assays ranging from trace to 43.6 oz/t Ag, trace to 0.54 oz/t Au and trace Zn to 28.8%. Sampling at Big Nunatak returned up to 427 g/t Ag and 0.78% Cu. At the Glacier Creek property, 5.5 km northeast of the Porter mine site, a new mineralized vein was discovered with a 205 m strike length and widths of up to 2 m. Samples graded up to 876 g/t Ag and 10.8 g/t Au.

Decade Resources Ltd. carried out rock sampling on its **Premier East** project, adjacent to the historic Premier goldsilver mine. Results returned anomalous values for precious and base metals, including one sample that graded 5.72 g/t Au, 716 g/t Ag and 11.60% Cu.

8.3.2. North Central Region

ZincX Resources Corp. continued exploration on its Akie SEDEX project. In August, the company released a new Preliminary Economic Assessment which proposed a 4000 tpd underground mine feeding a 3000 tpd concentrator over a mine life of at least 18 years. In 2018, the company completed five drill holes totalling 2013 m, on the Southeast, North Lead

and Sitka, and Sitka extension zones. The most encouraging results came from the Sitka zone, a Zn-Pb massive barite unit about 4 km east of the Cardiac Creek deposit. Hole A-18-144 intersected 5.08 m at 3.78% of Zn and 1 m at 11.33% of Zn. Hole A-18-145 intersected 3.5 m at 3.72% of Zn, which included 0.86 m at 11.09% of Zn. In the 'Sitka extension, about 400 m along strike southeast of the Sitka zone, hole A-18-149 encountered 12.98 m grading 1.10% of Zn, including 2.18 m at 3.47%.

InZinc Mining Ltd.'s **Indy** project has been of exploration interest since the early 1980s. Hosted by carbonate rocks, it has generally been categorized as a Mississippi Valley-type (MVT) deposit, although SEDEX affinities have long-been recognized. In 2018, InZinc completed 11 holes totalling 1271 m. Drilling encountered mineralization in all holes, mostly at shallow depths. For example, hole IB18-008 intersected 5.76% of Zn, 0.48% of Pb and 3.41 g/t of Ag over 6.73 m at 56 m depth. Hole IB18-009 intersected 12.33% of Zn, 2.98% of Pb, and 24.46 g/t of Ag over 6.29 m at 60 m depth. The company now considers **Indy** to be a vent-proximal SEDEX deposit equivalent in age to others in north-central British Columbia.

8.3.3. Southeast Region

Rokmaster Resources Corp.'s **Duncan** property has been explored intermittently since the 1950s.

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, tabular bodies, separated by high-angle fault zones. Mapping, soil geochemistry and rock sampling was done on the property in 2018. Elevated grab sample results up to 23 g/t Ag, 12.5% Pb, and 21.4% Zn were returned from an area of recent logging. The company also conducted environmental baseline work; drill permits were received late in the year.

Prize Mining Corporation's **Kena-Daylight** project includes an 80% interest in the Kena and Daylight gold-copper properties (20% owned by Apex Resources Inc.), and 100% of the adjoining Toughnut claims. Results from late 2017 drilling were released in early 2018.

Results from Daylight included high-grade intersections of 0.9 m grading 62.7 g/t Au, 0.5 m grading 20.9 g/t Au, 0.5 m grading 7.36 g/t Au, and low-grade intervals of up to 74.28 m grading 1.09 g/t. At Toughnut, results included 0.7 m grading 7.3 g/t, 1.0 m grading 25 g/t Au, and 2.0 m grading 5.58 g/t Au. The company followed up in 2018 with further drilling at the Toughnut (3386 m, 20 DDH) across an area of 1000 x 450 m in the Silver King shear system targeting the Gold Eagle showing and the Toughnut Crown Grant workings. Results from the 2018 drilling include 4.37 g/t Au over 6.0 m and 14.3 g/t Au over 0.84 m.

Taranis Resources Inc. continued work at their **Thor** property, which has several targets, including the True Fissure, Great Northern, Broadview, and Blue Bell past-producing mines. In 2018, the company continued drilling (1983 m, 30 DDH) southeast of the Great Northern zone, as a follow up to 2016

drilling, which encountered stacked zones of mineralization, and step out mineralization. Results included 2.38 m grading 0.24 g/t Au, 149.1 g/t Ag, 2.32% Pb, 3.40% Zn, 0.08% Cu and 2.35 m grading 3.88 g/t Au, 5.20 g/t Ag. They also conducted resistivity, ground magnetics, and VLF surveys over portions of the property to better define structures and identify new targets. The company also processed a 600 t sample from the SIF zone using a pilot plant to test gold grades and recovery methods. In the field, it was estimated that the plant was only able to recover 25.3% of the gold because finer fractions were lost and using a hammer mill was inefficient. Future work would include the use of a ball mill to obtain a finer grind size and improve recoveries by liberating more gold. The company has applied for a 10,000 t bulk sample permit, and began collecting environmental baseline data and information required for permitting.

8.4. Selected skarn projects 8.4.1. North Central Region

The **Stardust** property was acquired by Sun Metals Corp. in 2017. Historically regarded as a skarn deposit, it was explored intermittently for many years. In 2018, the company extended previous mapping and prospecting, collected more than 2800 soil samples, completed an airborne lidar with photogrammetry survey, and a 1103 line-km VTEM and magnetic survey on a 100 m line spacing. Twenty-two drill holes were completed, totalling 6838 m, and a post-drilling downhole EM survey was undertaken. Hole DDH18-SD-421 returned a 100 m intersection grading 2.51% of Cu, 3.03 g/t of Au, 52.5 g/t of Ag. The company considers that this mineralization represents the distal part of a larger skarn.

8.4.2. South Central Region

At the **Fox** tungsten skarn property, Happy Creek Minerals Ltd. reported results of surface sampling at a previously untested area at the southern part of the Ridley Creek resource area. One sample graded 7.43% WO₃ across 0.35 m. Since 2005, work has identified seven, near-surface mineralized zones in a system extending across a 3 x 10 km area. In February, Happy Creek reported an update to the resource estimate with an Indicated 582,400 t 0.826 WO₃ and Inferred 565,400 t 1.231% WO₃.

Engold Mines Ltd.'s Lac La Hache project comprises several target areas including skarn, porphyry, vein and breccia mineralization. Work included diamond drilling and IP surveys at Cu-Au-Ag-Fe skarn targets (e.g., Spout North, Spout, G-1, Gap) and also a gold vein target in the southeastern part of the property (Aurizon). Highlight intersections include 8.8 m grading 3.26% Cu, 0.88 g/t Au, 16.88 g/t Ag, 26.7% Fe at Spout North; 31 m grading 1.14% Cu, 0.28 g/t Au, 6.89 g/t Ag, 24.31% Fe at G1 and 58.5 m grading 0.47% Cu, 0.06 g/t Au, 2.18 g/t Ag, 6.07% Fe at Gap. They obtained up to 25.6 g/t Au in grab samples near the Aurizon and Au in soil anomalies. Drilling continued into late 2018.

Nicola Mining Inc.'s **New Craigmont** project includes the past-producing Craigmont mine and surrounding area. Nicola

is exploring for additional copper-iron skarn near the mine and evaluating historical waste dumps as potential ore by using reverse circulation drilling. Exploration included diamond drilling, and IP surveys at several zones. An intersection in a hole north of the Craigmont pit returned 73.6 m grading 1.05% Cu. Early in the year, they reported 100.6 m grading1.33% Cu at the Craigmont West zone. Target mineralization is coppergold skarn in calcareous Nicola Group rocks cut by a southern border phase of the Giuchon Creek batholith.

8.5. Selected mafic- and ultramafic-hosted projects 8.5.1. Northwest Region

At their **Nickel Mountain** project Garibaldi Resources Corp. carried out a 32-hole 11,573 m diamond drilling program. Highlight results for 10 holes include 30.5 m of 3.10% Ni, 1.86% Cu, 0.081% Co, 0.863 g/t Pt, 1.776 g/t Pd, 0.739 g/t Au, 7.3 g/t Ag and 5.6 m of 7.60% Ni, 3.36% Cu, 0.198% Co, 0.668 g/t Pt, 0.814 g/t Pd, 0.466 g/t Au, 9.0 g/t Ag. Results for the remaining 22 holes are pending. Additional drilling in 2019 is planned.

Giga Metals Corp. diamond drilled 10,835 m (40 holes) at their **Turnagain** project to test new targets, provide infill, collect samples for metallurgical testing, and yield geotechnical information for pre-feasibility studies. The project has Measured and Indicated resources of 865 Mt at 0.21% Ni, 0.013% Co, and an additional Inferred resource of 976 Mt at 0.2% Ni, 0.013% Co.

8.5.2. Northeast Region

FPX Nickel Corp filed a resource update for the Baptiste deposit at their **Decar** project. The deposit is reported to have a pit-constrained resource of Indicated 1.84 Bt grading 0.123% Ni and Inferred 390.8 Mt grading 0.115% Ni. In the fall, the company announced starting a metallurgical study.

8.6. Selected specialty metal projects 8.6.1. North Central Region

Ethos Gold Corp. began work on its **Pine Pass** black shalehosted vanadium prospect. In 2018, the company completed five hand-dug trenches and continuous rock chip samples in a road cut along Highway 97. Trench 1 returned grades averaging 0.27% of V₂O₅ over 255 m across strike, and Trench 2 gave grades averaging 0.43% of V₂O₅ over 155 m across strike. The company's immediate plan is to conduct a deep IP survey and continue trenching in an effort to define a drill program.

Spectrum Mining Corporation announced in late 2018 that a 30 t bulk sample would be collected from historic trenches and a drilling program at up to 51 sites would be started at their **Widheeda** project. The Wicheeda carbonatite is a deformed 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. A non-NI 43-101 compliant resource estimate concluded that, at an LREE cutoff of 1.00%, the deposit contained an indicated resource of 11.26 Mt grading 1.95% LREE (1.16% cerium, 0.54% lanthanum, 0.24% neodymium, 0.03% niobium, and 0.01% samarium).

8.6.2. South Central Region

Blackstone Minerals Limited acquired the Little Gem cobalt-gold prospect in 2017. The property includes the Jewel prospect approximately 1 km to the north. Jewel was a minor producer of gold, silver and copper in 1938-1940. Work in 2018 included drilling, an IP survey, rock, soil, and stream-sediment geochemistry and prospecting. Since acquiring the project, Blackstone reported additional targets, including Roxey, a gold-copper showing, and Erebor, which returned cobalt, gold, nickel and copper assays from rock samples. Some initial drill results include 4.3 m grading 1.0% Co and 15 g/t Au and 3.2 m grading 0.8% Co and 4 g/t Au. The Little Gem hosts vein-type cobalt- gold mineralization with anomalous Ag, Ni, Bi, U and As.

8.7. Selected coal projects

8.7.1. Northwest Region

In 2018, Allegiance Coal Limited continued to move the **Tenas** project forward through their wholly owned subsidiary Telkwa Coal Limited. Eight PQ diameter holes were drilled, three for the installation of water monitoring wells and five to collect rock samples for geochemical studies and coal testing. Twelve sonic holes were drilled for geotechnical information. Fourteen large diameter (150 mm) holes were drilled, recovering 1400 kg of coal. The coal was sent for sizing, washability, and comprehensive coal quality analyses and to generate samples for coke oven tests. In November it was announced that Itochu Corporation of Japan (Itochu) was investing in the project. A definitive feasibility study was expected in early 2019.

8.7.2. Northeast Region

Colonial Coal International Corp. released a preliminary economic assessment on its **Huguenot** project. As a combined open-pit and underground operation, Huguenot was estimated to have an NPV of \$US1.166 million in metallurgical coal based on \$US172.00 per t, with break-even at \$US 120.00 per t. Measured plus Indicated surface mining resources across three resource blocks were reported as 132.0 Mt, and underground as 145.7 Mt. Mine life was projected at 31 years.

8.7.3. North Central

Atrum Coal's **Panorama** project is a joint venture of Atrum Coal Limited (65%) and Japan Oil, Gas and Metals National Corporation (JOGMEC) (35%). In 2018, Atrum conducted drilling on the Panorama North deposit, targeting PCI anthracite coal in an open syncline for blending to produce metallurgical coal. Eight holes were completed, totalling 1979 m, and seam thicknesses of up to about 4 m were identified.

8.7.4. Southeast Region

Pacific American Coal Limited drilled on their **Elko** project in 2018 (8 RC, 1 large-diameter core; 3451 m). Coal quality results are pending, but correlation of geophysical drill logs suggest seam continuity, and will be used to update the geological model. The company began working on the project in 2015, and compiled all the historical data into a model to outline the drill locations. The company also has conducted extensive environmental baseline work, and engagement with the First Nations to receive the necessary permits for exploration.

8.8. Selected industrial mineral projects 8.8.1. Southeast Region

MGX Minerals Inc., continued to explore on their Koot, Gibraltar and Wonah projects. At Koot, the company drilled (782 m, 10 DDH), reporting intersections of quartzite 36 to 105 m thick with 97.9 to 99.0% SiO₂. At Gibraltar, MGX collected a one-ton sample and testing indicated that the material could be suitable as medium quality feedstock for metallurgical-grade silicon metal production. They also 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. At Wonah geological mapping and sampling was done; 11 chip samples were assayed between 98.9 and 99.9% SiO₂. The company received drill permits and began road construction, and plans to drill in 2019.

9. Publically funded geoscience

9.1. The British Columbia Geological Survey

Founded in 1895, the British Columbia Geological Survey (BCGS) is the oldest scientific agency in the province. The Survey conducts research to establish the geological evolution and mineral resources of the province. Drawing on continuously advancing concepts and technologies, the Survey creates knowledge to guide societal decisions centred on the Earth sciences. The information provided by the Survey is used for effective mineral exploration, sound land use management, and responsible governance. This information benefits 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 provides investment intelligence to government and global business, connecting the national and international investment community to the Survey and to the province's geology and mineral resources.

In 2018, the BCGS had field projects throughout the province. The BCGS levers its resources by partnering with federal, provincial and territorial governments, and with other national and international organizations. In the northwest, the BCGS partnered with the Geological Survey of Canada (GSC) in the final year of a Targeted Geoscience Initiative (TGI 4) project assessing gold deposits near the Llewellyn fault and its possible extension into Yukon as the Tally Ho shear zone. Work continued on a major regional program focussed on

the 'Golden Triangle', including a study near Iskut and a BCGS-GSC collaboration under TGI 5 looking at geodynamic controls on porphyry and epithermal-style mineralization near Stewart. In central British Columbia, a new multi-year mapping project was initiated focussed on northern Hogem batholith. The new mapping will provide a modern understanding on the controls of diverse mineralization types in the region, particularly porphyry deposits. North of the Hogem batholith, another BCGS-GSC TGI 5 project was initiated to examine the geological framework of the Polaris intrusion. This project builds on ongoing work of the Tulameen ultramafic body, and is designed to further refine our understanding of Ni-Cu-PGE ore-forming processes in these Alaskan-type intrusions. In southern British Columbia, multi-year projects re-defining the stratigraphic framework of the Nicola arc entered their final field seasons, and a new project targeting Co-rich volcanogenic massive sulphide deposits in the Kootenay arc started. Work continued on the Upper Fir rare Earth element deposit and will incorporate data gathered from the Ice River carbonatite body. Also part of TGI 5, is a joint BCGS-GSC-Geological Survey of Japan collaboration examining specialty metals. BCGS continues to develop new exploration methods, including indicator minerals from till. 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, and are published in Geological Fieldwork, a volume of papers released each January (Fig. 17), 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 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.

9.2. 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 (TGI 5) program. The TGI5 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



Fig. 17. Geological Fieldwork contains peer-reviewed papers that summarize field activities and current research by the British Columbia Geological Survey.

ore metals. In addition, surficial geology and glacial history studies will provide vital knowledge for mineral exploration in covered regions.

9.3. Geoscience BC

Geoscience BC, a not-for-profit, non-government geoscience organization funded by provincial government grants, also provides provincial geoscience information. Geoscience BC 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.

10. 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.

11. Concluding remarks

Exploration expenditures were up for the second year in a row and new discoveries were made. 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.

At the end of 2018, eleven metal mines were in production. In early 2019, it was announced that the Mount Polley mine was suspending operations. Six open-pit coal mines were in production at the start of the year, five in the Southeast Region and two in the Northeast Region. As well, one underground mine produced on Vancouver Island. The Willow Creek mine restarted in July, bringing the total number of operating coal mines in the Northeast Region to three. In the fall, the Coal Mountain mine in the Southeast Region suspended mining operations.

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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 basinal 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** (Perry Creek), **Brule**, and **Willow Creek** operations, two mines on care and maintenance status, 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. Also owned by Centerra Gold Inc., the **Kemess Underground** project (porphyry Cu-Au) received its Mines Act permit in 2018. Graymont Western Canada Inc. applied for a Mines Act permit for its **Giscome** project. The **Blackwater** epithermal Au-Ag project (New Gold Inc.) remained in mine evaluation status, as did Taseko Mines' **Aley** niobium (carbonatite) project (Fig. 1).

Significant mine lease exploration programs in 2018 included on-lease drilling at each of the **Willow Creek**, **Brule**, and **Wolverine** mines in the Northeast Region, and at the Mt. Milligan mine in the North Central Region. The regions also saw numerous other exploration projects: five grassroots; 23 early stage; three advanced stage; and two mine evaluation stage (Fig. 1). At one of the grassroots projects (**AK**), a few km north of Prince George, an orogenic Au prospect was

discovered. Exploration diamond drilling was undertaken at 15 projects, the most significant of which occurred on- and offlease at Centerra Resources' **Mt. Milligan** mine, at Serengiti Resources' **Kwanika** project, and at Sun Metals' nearby **Stardust** project. Significant coal exploration drilling was completed by Atrum Coal Limited at its **Panorama North** 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 Ernst & Young LLP. For the North Central Region, exploration expenditures were estimated at \$32.7 million and exploration drilling was estimated at approximately 69,100 m. For the Northeast Region exploration expenditures were estimated at \$6.3 million and exploration drilling was estimated at approximately 15,000 m (Clarke et al., this volume: Ernst &Young LLP (EY), 2019, in press).

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

DeGrace



Fig. 1. Mines and selected exploration projects, North Central and Northeast regions, 2018. Terranes after Nelson et al. (2013).

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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; Jago, 2017). Thus, platformal rocks deposited above Ancestral North America host coal and potash deposits, and postaccretionary sedimentary rocks overlying the Stikine terrane host coal deposits. Deep-water basin strata host SEDEX and Mississippi Valley-type lead-zinc deposits, and are intruded by carbonatite bodies hosting niobium and rare earth elements (REE). The island arc assemblages of Quesellia and Stikinia host the known large polymetallic porphyry and orogenic precious metal deposits in the region.

Both regions were extensively glaciated during successive Quaternary glacial periods (e.g., Hickin et al., 2017). Glaciation resulted in significant topographic modification so that, especially in mountainous areas, glacial valleys, cirques and arêtes, and attendant surficial deposits are widespread. In the Interior Plateau, till thicknesses commonly extend to several metres. Glaciofluvial deposits are widespread; glaciolacustrine deposits are in some low lying areas, such as near the confluence of the present day Nechako and Fraser Rivers.

3. Mines and quarries

3.1. Metal mines

In 2018, **Mt. Milligan** (Cu-Au), wholly-owned by Centerrra Gold Inc., was the only producing metal mine (Table 1). In July 2018, the company received a Mines Act Permit for its Kemess Underground project in the Toodoggone area.

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 x 1500 m) is a silica-saturated alkalic porphyry deposit in which Cu-Au (with accessory Ag) mineralization is

Table 1. Metal mines, North Central and Northeast regions.

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, and by 2016 was up to its full design capacity of 60,000 td. In 2018, Centerra was well established in its Phase 3 mining operation (Fig. 2) and was moving on to Phase 4. Ore is initially processed through primary and secondary crushers, before milling and flotation in a 62,500 tpd design capacity concentrator (Fig. 3). Mill feed throughput in 2017 was forecast to be 59,600 tpd, and for 2018 to be 60,700 tpd (Andrews et al, 2017) but, early in 2018,



Fig. 2. Mt. Milligan mine open pit: Phase 3 blast area.



Fig. 3. Mt. Milligan mine concentrator; tailings ponds in background.

Mine	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2018 Production (based on Q1- Q3)	Reserves	Resource	Comments
Mt. Milligan	Centerra Gold Inc. (Centerra B.C. Holdings)	Cu, Au, Ag; alkalic porphyry Cu-Au; 093N 194, 191	40-47 Mlbs Cu 175-195 Koz Au	P: 236.5 Mt at 0.187% Cu and 0.424 g/t Au Pr: 239.4 Mt at 0.188% Cu and 0.293 g/t Au	M+I: 243.9 Mt at 0.16% Cu and 0.2 g/t Au (additional to reserves)	Concentrator design capacity 62,500 tpd. Estimated mine life 22 years. More than 350 employees.

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

water shortages forced the mill to be closed temporarily. 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. Combined Measured and Indicated Mineral resources are 243.9 Mt at 0.134% Cu and 0.226 g/t Au containing 717.7 Mlb of Cu and 1.77 Moz of Au (Andrews et al., 2017). In 2017, Proven and Probable reserves decreased to 468 Mt at 0.3 g/t Au from 496.2 Mt at 0.4 g/t reported in 2016. Average annual payable production forecast for 2017-2019 is 76.8 Mlb of Cu and 253,700 oz of Au, and the estimated mine life is 22 years (Andrews et al., 2017). In 2018, the company undertook near-pit infill and expansion drilling, with 52 holes totalling 19,250 m to explore below depths drilled previously.

3.2. Coal mines

Having acquired three open-pit metallurgical coal mines from Walter Energy Canada Holdings Inc. in 2016, Conuma Coal Resources Ltd. is producing from the **Willow Creek** mine (Table 2; Fig. 4, reopened in July 2018), the **Wolverine** mine (reopened in January 2017), and the **Brule** mine (reopened in late 2016).

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

Conuma Coal began ramping-up production at its **Willow Creek** mine in July 2018 (Fig. 5), and by year-end had produced an estimated 482,000 t of hard coking coal and pulverized coal injection (PCI) product. In 2018, the Company completed a major on-lease drilling project to both define and expand the mineable resource. Drilling was completed in 27 diamond drill holes (totalling 3680 m) and 10 reverse circulation holes (totalling 1023 m), all of which were geophysically logged.

Table 2. Coal mines, North Central and Northeast regions.

3.2.2. Brule mine (Conuma Coal Resources Ltd.)

Production continued at Conuma's **Brule** mine, from which about 2.47 Mt ROM of premium ultra-low volatile PCI metallurgical coal was released from three seams in the lower part of the Gething Formation (Cretaceous; Bullhead Group). The coal is contained in variably dipping 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. Late in November the company began drilling to further develop the coal resource, with a planned 35 rotary holes totalling about 8000 m, all of which were to be surveyed and geophysically logged.

3.2.3. Wolverine (Perry Creek) mine (Conuma Coal Resources Ltd.)

The **Perry Creek** mine, within the larger Wolverine project area, produces medium-volatile bituminous hard coking coal (HCC) from the Gates formation in the Fort St. John Group (Cretaceous). 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. Reserves at Perry Creek, at 6.9 Mt, are the smallest of Comuma's three mines. Opportunities for open-pit expansion are limited but the company began an on-lease exploration program of about 4 drill holes in December 2018, to begin setting the parameters for underground mining.

3.3. Industrial mineral mines and quarries

In 2018, only one industrial mineral producer, Fireside 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).

Mine	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2018 Production (based on Q1- Q3)	Reserves	Resource	Comments
Willow Creek	Conuma Coal Resources Limited	HCC, PCI; bituminous coal; 093O 008	482,000 t ROM	P: 16.1 Mt saleable	na	About 220 employees, mine and plant. Restart began in July 2018. On-lease exploration program to extend resource base.
Brule	Conuma Coal Resources Limited	PCI; bituminous coal; 093P 007	2.47 Mt ROM	P: 14.8 Mt saleable	na	About 230 employees. November 2018, began on- lease exploration program to extend resource base.
Wolverine (Perry Creek)	Conuma Coal Resources Limited	HCC; bituminous coal; 093P 025	1.89 Mt ROM	P: 6.9 Mt saleable	na	About 300 employees, mine and plant. December 2018. began on-lease drill program to help set the parameters for underground mining.

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



Fig. 4. Coal mines and exploration projects, northeastern British Columbia, 2018. From British Columbia Geological Survey (2019).

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Fig. 5. Willow Creek Mine, shovel, haul truck and blasthole drill.

3.3.1. Fireside Barite (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% $BaSO_4$. The product is bagged and trucked to Fort St. John and to Alberta, where it is used to produce high-density drilling mud. In 2018, production amounted to an estimated 30,000 t from the Moose Pit, which opened in 2016.

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 2018, 98 placer gold operations were approved in British Columbia, 26 of which were in the North Central Region. These were distributed primarily in the Manson Creek, Fort St. James to Mackenzie, and Hixon areas, with total surface disturbance estimated at 20.45 ha. 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. These paleochannels do not necessarily follow modern drainage patterns.

5. Mine or quarry development

One mine is under development in North Central and Northeast regions. Centerra Gold's **Kemess Underground** project, which received Mines Act approval in 2018, is in the earliest stage of construction.

5.1. 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.

In a technical report issued in July 2017, KUG was estimated to contain 246.4 Mt of Indicated resource containing 1.195 Mlbs of Cu, 3.3 Moz of Au, and 13.9 Moz of Ag. Within this resource are Probable reserves of 107.4 Mt containing 629.6 Mlbs of Cu, 1.9 Moz of Au and 6.7 Moz of Ag.

In July 2018, a Mines Act permit for KUG was issued and by the end of September the North Tunnel portal was complete. Excavation was underway at the South Portal entrance and a nearby staging area was nearly complete, with the adit itself to be started in early 2019. Mine startup is anticipated in about 2022. During the construction period the project will provide about 575 jobs, dropping to about 475 with the start of mining operations.

The former **Kemess South** (KS) mine closed in 2011. However, KS infrastructure remains in place, and both the camp and ore processing plant will be used to service the newly developed mine, which is about 6.5 km north of the KS processing plant. KUG is considered a stand-alone operation, to be mined by panel caving with crushed ore conveyed underground to the process plant. **Kemess East** (KE), about 1 km east of KUG, is also being treated as a stand-alone underground operation, but will use facilities developed for KUG. Waste rock and tailings from KUG will be placed in the

Mine	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2017 Production (based on Q1-Q3)	Reserves	Resource	Comments
Fireside (Northeast Region)	Fireside Minerals Ltd.	Barite; vein barite; 094M 003, 19	30,000 t	P+Pr: 475,000 t (non NI 43-101 compliant)	na	Mined from the Moose Pit, with possible extension to north.
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.

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

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

KS 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.

6. Proposed mines or quarries

Two mines were at the proposal stage in 2018: **Blackwater** (New Gold Inc.), and **Aley** (Taseko Mines Ltd.). Aley saw significant drilling activity in 2018, and Blackwater plans drilling in 2019. In the Northeast Region, the **Murray River** (HD Mining International Ltd.) and **Sukunka** (Glencore Canada Corporation and JX Nippon Oil and Energy Corporation) coal projects are proposed for development, with Murray River having its Mines Act approval in place. Graymont Western Canada's **Giscome** limestone quarry is the sole significant industrial mineral proposal.

6.1. Proposed metal mines

There are two proposed metal mines, New Gold Inc.'s **Blackwater** Au-Ag project and Taseko Mines Ltd.'s **Aley** niobium project (Fig. 1; Table 4).

6.1.1. Blackwater (New Gold Inc.)

The **Blackwater** project is accessible by existing roads, but development would require construction of a 140 km transmission line from a substation south of the community of Endako. Proven reserves stand at 124.5 Mt at 0.95 g/t of Au and 5.5 g/t of Ag. As proposed, Blackwater would be a 60,000 tpd operation with a 17-year mine life. The mine operation, once completed, would consist of an open pit, ore processing facility, waste rock dump, 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 hydrofractured 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 northeast- and northwest-trending faults.

In 2018, New Gold continued advancing its environmental assessment process and coordinated with both federal and provincial governments, with the aim of meeting the requirements for Environmental Assessment Certificate (EAC) from the Province of British Columbia, and a Decision Statement from the federal Minister of the Environment. In November 2018, the Canadian Environmental Assessment Agency began a 30-day public and indigenous comment period on its draft Environmental Assessment report. New Gold continued collecting baseline data, completed additional soil and till sampling, and undertook geotechnical work related to mine design.

New Gold plans a major drilling program of up to 75,000 m over five years to extend the known resource and to collect material for metallurgical studies.

6.1.2. Aley (Taseko Mines Ltd.)

Taseko Mines Ltd.'s wholly-owned **Aley** niobium-bearing carbonatite project is near the western extremity of platformal strata. The dolomite carbonatite intrusion (with minor calcite carbonatite) is oval in map view, measuring about 2.0 x 2.8 km. Within that body, reserves stand at 84 Mt grading 0.5% of 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 2018, Taseko completed 25 drill holes at Aley, sited within the perimeter of previous exploration drilling and totalling 2700 m, to collect material for further metallurgical testing.

6.2. Proposed coal mines

HD Mining International's **Murray River** project received its Mines Act approval in 2018 and awaits a final investment decision. Progress on Glencore's **Sukunka** project was suspended pending the resolution of environmental concerns.

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 (Table 4). In 2015 HD Mining International Ltd. had completed bulk sampling for testing coal quality, processing, and marketability. Earlier concerns about the potential of impact on the Quintette herd of Southern Mountain Caribou were addressed and, in April 2018, the company received its Mines Act permit to begin operations. The adit in place at present (driven to collect the bulk sample in 2015, but also to be used for the mining conveyor) descends 1.3 km down a decline (Fig. 6). 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 over a 25-year mine life. Chinese miners experienced in longwall methods would start production, but



Fig. 6. Portal to HD Mining International's Murray River mine.

Table 4. Proposed mines and quarries, North Central and Northeast regions.	
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Project	Operator (partner)	Commodity; deposit type; MINFILE	Reserves	Resource	Comments
Aley (North Central Region)	Taseko Mines Ltd.	Nb; carbonatite- hosted deposit; 094B 027	P+Pr: 83.8 Mt at $0.50\% \text{ Nb}_2\text{O}_5$ (at $0.30\% \text{ Nb}_2\text{O}_5$ 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 niobium over a 24-year mine life. In 2018, completed 24 boreholes, 2700 m total for metallurgical testing.
Blackwater (North Central Region)	New Gold Inc.	Au, Ag; epithermal Au-Ag-Cu (intermediate sulphidation); 093F 037	P: 124.5 Mt at 0.95 g/t Au, 5.5 g/t Ag, containing 3.79 Moz Au, 22.1 Moz Ag. Pr: 169.7 Mt at 0.68 g/t Au, 4.1 g/t Ag, containing 3.73 Moz Au, 22.3 Moz Ag	M: 117 Mt at 1.04 g/t Au, 5.6 g/t Ag containing 3.90 Moz Au, 21.06 Moz Ag. I: 189 Mt at 0.78 g/t Au, 6.0 g/t Ag, containing 4.73 Moz Au, 36.47 Moz Ag, additional to reserves	Environmental Assessment (under review), engineering and environmental studies. Proposed open-pit mine with 60,000 tpd ore processing rate and life-of-mine average annual production of 12.8 t (413 Koz) Au and 54.2 t (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 285.6 Kt (629.6 Mlbs) Cu, 58.1 t (1.87 Moz) Au, 214 t (6.88 Moz) Ag	I: 246.4 Mt at 0.22% Cu, 0.42 g/t Au, 1.75 g/t Ag; containing 542.2 Kt (1195 Mlbs) Cu, 103 t (3.33 Moz) Au, 431.3 t (13.87 Moz) Ag; inclusive of reserves	Mine permit approved July 2018. Mine start-up estimated for 2022. Proposed underground panel cave mine with 24,600 tpd ore processing rate and life- of-mine average annual production of 3.30 t (106,000 oz) Au and 21 Kt (47 Mlbs) Cu over a 12-year mine life.
Murray River (Northeast Region)	HD Mining International Ltd.	Coal; bituminous; 093I 035	P: 261.6 Mt 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.

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

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 Canada Corporation 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 (Table 4). The environmental assessment process was suspended in January 2016, and remains so pending further study on the effects upon caribou and water quality.

6.3. Proposed industrial mineral mines or quarries 6.3.1. Giscome (Graymont Western Canada Inc.)

At the **Giscome** project in the North Central Region (Fig. 1; Table 4), Graymont Western Canada proposes to exploit a high-purity limestone deposit in basaltic rocks of the Triassic Antler Formation (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 2020, 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.

7. Selected exploration activities and highlights

Exploration projects in 2018 (Tables 5, 6) proceeded at about the same overall level of activity as in the previous year but with some notable additions, including drilling at **Lawyers** (Benchmark Metals Inc.), **Fran** (MGX Minerals Inc.), and **Stardust** (Sun Metals Corp.). Two new greenfield projects were **AK** (Au; Exodus Mineral Exploration Ltd.) and **Pine Pass** (V₂O₅; Ethos Gold Corp.)

7.1. Selected precious metal projects

Seven significant precious metals projects were underway in 2018, of particular note **Lawyers** (Benchmark Metals Inc.), and **Snowbird** (Gitennes Exploration Corp.). **AK** (Exodus Exploration Ltd.) was a 2018 discovery.

7.1.1. AK (Exodus Mineral Exploration Ltd.)

The **AK** Au 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. Grab sampling of veins and shear zones followed clearing of newly exposed bedrock and hand trenching. Ninety-four rock specimens were analyzed, and 126 soil samples were taken. Analysis of one specimen from the discovery vein returned 8 g/t Au; others contained from 2.0 to 5.5 g/t of Au and low values of antimony. One sample from a shear zone in contact with the 'discovery vein' returned about 3 g/t of Au.

7.1.2. Gibson (CANEX Metals Inc.)

CANEX completed 10 holes totalling 1001 m on this precious metal-bearing vein deposit, nine of which were spaced at roughly 20 m intervals to explore a known resource, and one of which was a 'step out', about 300 m from the others. All holes, and two trenches, were within about 1 km of the Hogem batholith, and targeted Ag mineralization with associated galena. A new zone of quartz-sulphide veins was discovered adjacent to the main Gibson trend. The company reported that drilling intersected multiple quartz-sulphide veins containing pyrite, sphalerite, galena, and minor chalcopyrite, arsenopyrite and sulphosalts (Fig. 7).



Fig. 7. Gibson project, hole G18-10, 62.8 m, late-stage very fine grained quartz-sulphide veinlets (dark grey) cutting mineralized Takla Group host rock.

7.1.3. JD (Freeport-McMoRan Mineral Properties Canada Inc.)

JD is a low-sulphidation epithermal Au and Ag prospect hosted by a vein, breccia, and stockwork network. The company completed 41.45 line km of IP and 671 line km of airborne magnetometer surveys, and drilled 2 holes totalling 1294 m.

7.1.4. Lawyers (Benchmark Metals Inc.)

The **Lawyers** deposit is a low-sulphidation epithermal vein and stockwork system hosted by Lower Jurassic fragmental volcanic units of the Toodoggone Formation. Benchmark Metals now considers that Lawyers resembles a porphyry-style deposit, with potential for bulk tonnage. In 2018, Benchmark completed a 30 hole, 4116 m exploration drilling program on the Duke's Ridge, Cliff Creek and Phoenix zones. The company also relogged and sent for assay 1051 m of historic mineralized core from the Duke's Ridge and Cliff Creek zones, collected 1041 soil and 312 rock samples for assay, and completed an airborne VTEM survey. Highlight results from new core include 4.36 m at 6.15 g/t Au and 124.37 g/t Ag (hole 18PXDD001) and 3.05 m at 5.62 g/t Au and 292.31 g/t Ag (hole 18CCRC009). The company considers that the Phoenix, Duke's Ridge and Cliffs Creek zones may be connected. Grab samples from the nearby

Project	Operator (partner)	Commodity; deposit type; MINFILE	Resource (NI 43-101 compliant unless indicated otherwise)	Comments
17-001 to 17-004	Sil Industrial Minerals Ltd.	Sand and gravel (as frac sand)	na	33 hammer drill and auger holes totalling 200 m.
AK	Exodus Mineral Exploration Ltd.	Au-quartz veins	na	Hand trenching and grab sampling returned up to 8 g/t Au.
Akie	Canada Zinc Metals Corp.	Zn, Pb, Ag; sedimentary exhalative Zn-Pb-Ag; 094F 031	Updated 43-101: 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, 12.9 g/t Ag, all at 5% Zn cut-off	5 holes on Sitka extension of Cardiac Creek zone, 2013 m total, 567 samples taken. All holes intersected mineralization. June PEA proposed 18-year mine life, mine production rate 4000 tpd, 25.8 Mt total mined, initial capital cost \$302.3 million.
Atty	Serengeti Resources Inc.	Cu, Mo, Au; porphyry Cu±Mo±Au	na	Trenching and sampling.
Cathedral	Thane Minerals Inc.	Cu, Au; alkalic porphyry Cu- Au; 094C 018, 48, 72, 109	na	Mapping, sampling, IP.
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)	Relogged 17 holes, 3450 m of historic core.
Copper King	Pacific Empire Minerals Corp.	Cu, Au; alkalic porphyry Cu- Au; 094D 004, 149, 150, 151	na	4 RC holes, total 459 m. Significant Cu, Au and Ag assays returned.
Croy-Bloom	Serengeti Resources Inc.	Cu, Au; alkalic porphyry Cu- Au; 094D 015, 25, 094C 039, 156	na	11.5 line-km IP.
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	Metallurgical study to improve on 2013 results. Announced an updated mineral resource estimate.
Fran	MGX Minerals Inc.	Cu, Au; alkalic porphyry Cu- Au; 093K 108, 093N 207	na	112 line-km IP, 10 holes total 3000 m intersected "numerous zones of late-stage infilling sulphides."
Gibson	Canex Metals Inc.	Au, Ag, Cu; epithermal Au- Ag-Cu, low sulphidation; 093N 185	na	10 holes total 1001 m. Intersected quartz-sulphide veins up to 2.5 m in thickness.
Gnome	AsiaBaseMetals Inc.	Zn, Pb, Ag; sedimentary exhalative Zn-Pb-Ag; 094F 011, 16	na	Prospecting, mapping, and soil and rock sampling. Anomalous Co, Zn, Mn.
Indy	InZinc Mining Ltd.	Zn, Pb, Ag; sedimentary exhalative Pb-Zn-Ag; 093N 240	na	11 holes total 1271 m. Significant Zn, Pb, Ag intersected.

 Table 5. Selected exploration projects, North Central Region.

JD	Freeport McMoRan Mineral Properties Canada Ltd.	Au, Ag; epithermal vein Au- Ag; 094E 171	na	2 holes, 1294 m, 42.6 line-km IP, 671 line km airborne magnetics.
Joy	Amarc Resources Ltd.	Cu, Mo, Au; porphyry Cu±Mo±Au; 094E 106	na	Completed 3 holes total 1527 m to test coincident IP and geochem anomalies. Airborne mag, 49 line- km IP, 638 talus fine samples for analysis, mapping. Farm-in agreement with Hudbay Mining (Amarc was 2017 operator).
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	27 line-km IP on Nugget, Hilda South, Oriobn, Kemess South extension targets. Relogged historic core, revised deposit model.
Kwanika	Kwanika Copper Corp. (65% Serengeti Resources Inc., 35% Daewoo Minerals Canada Corp.)	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	21 holes, 7411 m.
Lawyers	Benchmark Metals Inc.	Au, Ag, Cu, Zn; epithermal low sulphidation Au-Ag-Cu; 094E 066	Inf: Cliff Creek North 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	30 holes, 4116 m, soil and rock samples, airborne VTEM. Discovered two new zones, Marmot and Phoenix East.
Mt. Milligan on-lease (brownfield)	Centerra Gold Inc.	Cu, Au, Ag; alkalic porphyry Cu-Au; 094N 194, 093N 091	Producing mine; see Table 1	12 holes, 5559 m on Goldmark, North Slope, Saddle West zones. On-lease portion of 14 line-km IP.
Mt. Milligan off-lease (greenfield)	Centerra Gold Inc.	Cu, Au, Ag; alkalic porphyry Cu-Au; 094N 194, 093N 091	na	13 holes, 5616 m on Mitzi East (north of lease boundary, D2 and Heidi Stock (west of lease boundary), and Fugro-1 (south of lease boundary). Off-lease portion of 14 line-km IP.
Nechako Gold	Tower Resources Ltd.	Au, Ag; epithermal low sulphidation; 093F 060, 4	na	5 holes, 751 m. One significant hole: 10 m intersection at 0.22% Cu, 0.212 g/t Au.
Panorama North	Atrum Coal Panorama Inc., JOGMEC (Japan Oil, Gas, and Metals National Corporation)	Coal; anthracite; 104A 085, 89	na	8 holes, 1979 m targeting low-S PCI coal.
Pil (Pillar East)	Finlay Minerals Ltd.	Cu, Au, Ag; porphyry Cu±Mo±Au, epithermal; 094E 213, 215, 216, 217	na	Trenching discovered new mineralized zones. 23 samples over 1 g/t Au, max 20.3 g/t. 15 samples over 50 g/t Ag, max 694 g/t.

Table 5. Continued.

Pine Pass	Ethos Gold Corp.	V; sediment-hosted; 093O 009	na	Trenching, sampling. Best result $0.45\% V_2O_5$ over 20 m.
Snowbird	Omineca Gold Ltd.	Au epithermal in quartz veins; 093K 036	na	10 holes, 1616 m. Connected North and Main zones, open at depth and along strike. Plans to focus on Main zone.
Stardust	Sun Metals Corp.	Ag, Pb, Zn; skarn Ag-Pb-Zn; 093N 009	na	22 holes, 6838 m, downhole EM survey. Mapping, prospecting, soil sampling, lidar survey, VTEM/ Magnetic survey.
UDS	Serengeti Resources Inc.	Cu, Au, Ag; porphyry Cu±Mo±Au; 094E 070	na	Expanded IP survey.
Vega	Canasil Resources Inc.	Cu, Au, Ag; porphyry Cu±Mo±Au; 104A 013	na	Lidar survey.
Wicheeda	Spectrum Mining Corporation	Nb, REE; carbonatite-hosted deposits; 093J 014	Inf: non NI 43-101 compliant 11.26 Mt, 2.3% LREE (Ce+La+Nd)	Beginning bulk sample, drilling program.
Wildcat	Pacific Empire Minerals Corp.	Cu, Au; alkalic porphyry Cu- Au; 093N 228	na	RC 11 holes, 550 m.

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
Brule	Conuma Coal Resources Ltd.	Coal; bituminous	P: 14.8 Mt saleable	On-lease exploration: estimated 40 +/-10 rotary holes, possible 8 +/-3 diamond holes, to extend resource.
Flatbed/Gordon Creek	Colonial Coal International Corp.	Coal; bituminous	Inf: 298 Mt	PEA report.
Huguenot	Colonial Coal International Corp.	Coal; bituminous	M+I: 132.0 Mt in situ surface, 145.7 Mt underground Inf: 119.2 Mt conbined	Continued environmental monitoring.
Willow Creek South	Conuma Coal Resources Ltd.	Coal; bituminous	na	On-lease exploration: 27 holes diamond drilling, 3680 m. 10 holes rotary drilling, 1023 m. Geophysical logging.
Wolverine	Conuma Coal Resources Ltd.	Coal; bituminous	6.9 Mt saleable	On-lease exploration: 4 +\-2 diamond holes to help set parameters for underground mining.

M = Measured; I = Indicated; Inf = Inferred

Marmot occurrence returned up to 38 g/t of Au and 1590 g/t of Ag. The company plans a large-scale drilling program for 2019, targeting the Marmot occurrence. A 2016 NI 43-101 technical report posited an inferred resource for the Cliff Creek North zone of 550 Kt at 4.51 g/t of Au and 2019.15 g/t of Ag, and for the Duke's Ridge zone of 58 Kt at 4.30 g/t of Au and 139.13 g/t of Ag, both with a 4.0 g/t AuEq cut-off.

7.1.5. Nechako Gold (Tower Resources Ltd.)

Tower Resources' targets on the **Nechako Gold** property are epithermal Au-Ag mineralization, and porphyry Cu-Au mineralization in the Hazleton Group (Upper Triassic to Middle Jurassic) and the Bowser Lake Group (Middle to Upper Jurassic).

In 2018, the company completed five short diamond drill holes totalling 751 m, following-up on a 2017 reverse circulation drill program. Only drill hole (NDH-18-004) showed significant results: 10 m at 0.22% Cu and 0.12 g/t of Au; and 14 m at 0.15% of Cu and 0.11 g/t of Au, including 2 m at 0.32% of Cu and 0.36 g/t of Au. Tower Resources planned to drill 15 reverse circulation holes in December 2018.

7.1.6. Pil (Finlay Minerals Ltd.)

Following-up on encouraging 2017 results, Finlay Minerals Ltd. undertook trenching and sampling on its newly discovered **Pillar East** Au-Ag epithermal zone, hosted by rocks of the Black Lake Plutonic suite (quartz monzonite and quartz diorite). The company collected 102 samples from 14 trenches cut across strike, sampling 500 m of an 800 m south-southwest trending mineralized zone, and identified 19 new Au-Ag mineralized sites. Twenty-three samples returned greater than 1.0 g/t of Au, with a maximum of 20.63 g/t of Au. Fifteen samples returned in excess of 50 g/t of Ag, with a maximum of 694 g/t. The company considers that the deposit forms a structural Au-Ag system consisting of silicified rocks, quartz veins, and quartz-carbonate breccias.

7.1.7. Snowbird (Gitennes Exploration Inc.)

The **Snowbird** project is an orogenic gold in quartz deposit that has been actively explored for at least 10 years. 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 (Fig. 8).

Gitennes has been exploring the property since 2016 and, in 2018, completed 10 holes totalling 1612 m. Results indicated continuity between the North and Main zones, and showed the mineralized area to be open at depth and along strike. Hole SB18-06 intersected 32 g/t Au over 1.32 m including 15.85 g/t of Au over 0.82 m. Hole SB18-02 intersected 24 g/t of Au over 0.7 m and 4.53 g/t of Au over 0.9 m. Hole SB18-03 intersected 81 g/t of Au over 0.5 m from 30.4 to 30.9 m. Sampling indicated Au values in both veins and shear zones. Gitennes planned further drilling, to total about 1600 m, before the end of 2018.



Fig. 8. Snowbird project, hole SB-18-03, 45 m, shear zone with stibnite in quartz stockwork.

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. Centerra Gold Inc. undertook intensive exploration in and around its Mt. Milligan mine, and Kwanika Copper Corporation continued work to develop its Kwanika project.

7.2.1. Cathedral (Thane Minerals Inc.)

The **Cathedral** porphyry prospect is hosted by quartz monzonitic plutonic rocks of the Hogem batholith (Early Jurassic), in contact to the east with intermediate volcanic rocks of the Takla Group (Late Triassic-Early Jurassic). Mineralization is within a west-plunging alkali porphyry system. In 2018, the company completed a modest program of mapping and grid establishment in advance of a planned 60 km IP program.

7.2.2. Chuchi (Centerra Gold Inc.)

The **Chuchi** Cu-Au property is at the northeast margin of the Hogem batholith (Early Jurassic), where a cluster of porphyritic monzonite stocks, dikes, and sills intrude the Chuchi Lake succession of volcanic and sedimentary rocks. In 2018, Centerra Gold relogged 3450 m of core from 17 drill holes to categorize vein types and density, and engaged in site cleanup.

7.2.3. Copper King (Pacific Empire Minerals Corp.)

The **Copper King** property is underlain by Triassic mafic to intermediate volcanic flows and breccias of the Takla Lake Group that are cut by Early Jurassic diorite, feldspar porphyry, and granodiorite. Mineralization is coincident with propylitic alteration and consists mainly of bornite-chalcocite-magnetiteepidote veins and of bornite-chalcocite disseminations in wall rock. Pacific Empire completed four reverse circulation holes, totalling 450 m, to test four targets on the property. Two holes intersected rocks with fine visible chalcocite disseminations associated with epidote with and without clay alteration. Samples returned low values of Cu, Au and Ag.

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 2018, Serengeti completed an 11.5 km IP program, and defined a large IP and resistivity anomaly coincident with encouraging soil and shallow drilling results from previous operators.

7.2.5. Fran (MGX Minerals Inc.)

In 2018, Rio Minerals Ltd., contracted by MGX, oversaw a 112 line-km IP survey and diamond drilling of 10 holes totalling 3000 m on this alkalic porphyry target. The deposit is hosted by volcano-sedimentary rocks of the Takla Group that are cut by en-echelon shear zones containing quartz-sulphide veins and stockworks. The company reports numerous zones of late-stage infilling sulphides (Fig. 9) as well as replacement pyrrhotite accompanied by chlorite, actinolite and mafic minerals, and high K-feldspar alteration. A follow-up drill program began in December. Upon completion of their exploration program, the company plans to issue an NI 43-101 report.



Fig. 9. Fran project, hole FR 18-90, 337 m, pyrite in hornfelsed siltstone.

7.2.6. Joy (Amarc Resources Ltd.)

In 2018, Amarc Resources Ltd., with its partner HDI (Hunter Dickinson Inc.), completed a 1356 km airborne magnetic survey, a 63 line km IP survey, extensive soil sampling, geological mapping, and a 2 hole, 946 drill program on its **Joy** property in the Toodoggone region. Exploration was focussed on the northeast-trending 'Finlay Magnetic Corridor', an area prospective for Au-Cu porphyry deposits underlain by the Hazleton Group (Upper Triassic to Middle Jurassic). The project identified 5 drill targets and plans an exploration program for 2019.

7.2.7. Kwanika (Kwanika Copper Corporation)

Kwanika Copper Corporation (65% Serengeti Resources Inc., 35% Daewoo Minerals Canada Corp.) was formed in 2017 to continue exploration on the **Kwanika** property. In 2018, the company completed a 21-hole, 7411 m drill program targeting the Central zone. Three of these were to test the foundation characteristics for a potential tailings storage facility. Nine of them were also to be used for ongoing hydrogeological monitoring to support detailed engineering design. The program was part of the company's ongoing "Kwanika Pre-

Feasibility Study," expected to be released in mid-2019 as a new NI 43-101 report.

The Central zone deposit is hosted by andesitic volcanic rocks of the Takla Group (Triassic) intruded by rocks related to the Hogem batholith (Triassic-Jurassic), with disseminated chalcopyrite, bornite and pyrite distributed in and around a potasically-altered monzonite stock. A supergene enrichment blanket with a maximum thickness of 70 m is contains native Cu, chalcocite and covellite (Fig. 10).

Kwanika (Central and South zones) has been the object of some 82,650 m of drilling since 2006. As conceived at present, a Kwanika (Central zone) mine would be a combined openpit and underground operation. The total Indicated resource for the open-pit portion, before taking 2018 results into account, is 11.8 Mt at 0.37% of Cu, 0.39 g/t of Au, and 1.07 g/t of Ag. For the underground portion, the Indicated resource is 41.4 Mt at 0.46% of Cu, 0.52 g/t of Au, and 1.36 g/t of Ag (Moose Mountain Technical Services, 2017). The 2018 drill program encountered generally higher values than had been predicted based on the 2017 Preliminary Economic Assessment resource model. For example, Hole K-182 returned 0.80 g/t Au, 0.66% of Cu and 2.24 g/t of Ag (2.19 g/t Au equivalent) over 500.3 m from 25.00 to 525.3 m, including 1.3 g/t of Au, 1.3% of Cu and 4.12 g/t of Ag (4.09 g/t AuEq) over 113.0 m, from 25.0 to 138.0 m. Drilling in 2018 confirmed that the Central zone has a higher grade core.



Fig. 10. Kwanika project, hole K-18-181, 317.5 m, native copper in supergene zone monzonite. Scale in cm.

7.2.8. Mt. Milligan on-lease, brownfield projects (Centerra Gold Inc.)

In 2018, Centerra Gold completed an extensive drill program within the ultimate pit boundary of the Mt. Milligan mine, below depths drilled previously (see 3.1.1., above). Results indicate that the ore body was displaced by a set of east-northeast trending normal faults. Twelve drill holes totalling 6669 m were completed to delineate the nearby Goldmark, North Slope and Saddle West zones. An IP program begun in 2017, which also extended off-lease, was also completed.

7.2.9. Mt. Milligan off-lease, greenfield projects (Centerra Gold Inc.)

Off-lease, but close to the Mt. Milligan mine, Centerra Gold completed 13 holes totalling 5616 m to test four areas for porphyry mineralization: **Mitzi East**, north of the mine lease boundary; D2 and Heidi Stock, west of the mine lease boundary; and Fugro-1, south of mine lease boundary.

7.2.10. UDS (Serengeti Resources Inc.)

The **UDS** prospect is immediately northeast of Centerra Resources' Kemess South mine, and appears to have formed in a similar geological setting. Mineralization in the area consists of vein-type epithermal precious metal occurrences and porphyry Au-Cu deposits. In 2018, Serengeti Resources expanded coverage of a previous IP survey.

7.2.11. Vega (Canasil Resources Inc.)

The **Vega** property is hosted by Takla Group volcanic rocks (Upper Triassic to Jurassic) that are cut by dikes and sills related to the Hogem batholith to the southwest. Mineralization occurs as pyrite, chalcopyrite, magnetite, and bornite along shear and fracture zones in brecciated and altered volcanic rocks and syenite. In 2018, Canasil Resources completed a lidar survey of the property.

7.2.12. Wildcat (Pacific Empire Minerals Corp.)

The **Wildcat** property is about 10 km southwest of the Mt. Milligan mine and, although covered by thick overburden (up to 30 m), the geological setting appears similar. Previous drilling (Cayden Resources in 2011) intersected rocks that were considered typical of a Cu-Au porphyry system. In 2018, Pacific Empire completed 11 reverse circulation holes in three areas. The lightweight reverse circulation drill unit (Fig. 11)



Fig. 11. Wildcat project, adding casing to reverse circulation drill rig.

was able to penetrate the thick overburden and then drill up to 60 m into bedrock. Material returned to the surface was screened using XRF scanning, but was not considered to be of sufficient interest to be sent for further analysis.

7.3. Selected polymetallic base and precious metal projects

The Kechika trough and its along-strike equivalents remained of interest for a variety of Pb-Zn SEDEX projects, in particular **Akie** (ZincX Resources Corp.) as an ongoing exploration program, and **Indy** (InZinc Mining Ltd.) as a renewed project.

7.3.1. Akie (ZincX Resources Corp.)

ZincX Resources continued exploration on its Akie SEDEX project. In August, the company released a new Preliminary Economic Assessment which proposed a 4000 tpd underground mine feeding a 3000 tpd concentrator over a mine life of at least 18 years. In 2018, the company completed five drill holes totalling 2013 m, on the Southeast, North Lead and Sitka, and Sitka extension zones. The North Lead zone is along strike with the Cardiac Creek deposit, about 3 km to the northwest. Drill hole A-18-148 in this zone intersected 125 m of zinc-enriched shale, limestone and siltstone of the Road River Group, including a 2.96 m interval at 0.31% of Zn. Similar results were found in holes A-10-68 and A-13-104 from previous drill programs. The Southeast zone is a previously untested target about 200 m outside of the Cardiac Creek deposit limits. Drill hole A-18-147 intersected a 7.04 m interval that graded 0.31% of Zn.

Perhaps the most encouraging results came from the Sitka zone, a Zn-Pb massive barite unit about 4 km east of the Cardiac Creek deposit within the 'eastern thrust panel' of Gunsteel Formation stratigraphy. This is the first known mineralized unit within this thrust panel. Hole A-18-144 intersected 5.08 m at 3.78% of Zn and 1 m at 11.33% of Zn. Hole A-18-145 (Fig. 12) intersected 3.5 m at 3.72% of Zn, which included 0.86 m at 11.09% of Zn. In the 'Sitka extension, about 400 m along strike southeast of the Sitka zone, hole A-18-149 encountered 12.98 m grading 1.10% of Zn, including 2.18 m at 3.47%.



Fig. 12. Akie project, hole A18-145, 175.3 m, sphalerite in quartz vein, Road River Group.

7.3.2. Gnome (AsiaBaseMetals Inc.)

The **Gnome** SEDEX prospect, south of the Akie project, is in a barite-rich sedimentary unit with anomalous values of zinc and other metals. In 2018, AsiaBaseMetals undertook prospecting, mapping, and sediment and soil sampling on the property, identifying drill targets. Rock samples were anomalous in Zn (up to 9840 ppm), Co (808 ppm) and Mn (10,000 ppm).

7.3.3. Indy (InZinc Mining Ltd.)

The Indy project has been of exploration interest since the early 1980s. Hosted by carbonate rocks, it has generally been categorized as a Mississippi Valley-type (MVT) deposit, although SEDEX affinities have long been recognized. Four anomalous areas (designated from north to south as Anomalies A, B, C, and D) have been identified within deformed rocks of the Black Stuart Group (Ordovician to Mississippian). In 2018, InZinc completed 11 holes totalling 1271 m, exploring the southern portion of Anomaly B. Drilling encountered mineralization in all holes, mostly at shallow depths. For example, hole IB18-008 intersected 5.76% of Zn, 0.48% of Pb and 3.41 g/t of Ag (6.18% ZnEq) over 6.73 m at 56 m depth. Hole IB18-009 intersected 12.33% of Zn, 2.98% of Pb, and 24.46 g/t of Ag (14.98% ZnEq) over 6.29 m at 60 m depth (Fig. 13). The company now considers Indy to be a ventproximal SEDEX deposit equivalent in age to others in northcentral British Columbia.



Fig. 13. Indy project, hole IB18-009, 79 m, galena, sphalerite and pyrite in quartz, Black Stuart Group.

7.4. Selected skarn projects

Sun Metals' **Stardust** project (formerly referred to as 'Lustdust') is the only significant skarn deposit in the North Central Region.

7.4.1. 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 (Fig. 14). Mineralization is hosted by the Sowchea, Pope and Copely successions, west of the Pinchi fault, in the Cache Creek terrane (Pennsylvanian-Permian). In 2018, the company extended previous mapping and prospecting, collected more than 2800 soil samples, completed an airborne lidar with photogrammetry survey, and a 1103 line-km VTEM and magnetic survey on a 100-m line spacing. Twenty-two drill holes were completed, totalling 6838 m, and a post-drilling downhole EM survey was



Fig. 14. Historic core at Sun Metals' Stardust property.

undertaken. Drilling of hole DDH18-SD-421 on the 'Canyon Creek extension zone' returned a 100 m intersection grading 2.51% of Cu, 3.03 g/t of Au, 52.5 g/t of Ag. The company considers that this mineralization represents the distal part of a larger system.

7.5. Selected specialty metal projects

Deep-water basinal strata east of the Rocky Mountain Trench host a number of specialty metal projects, including Taseko Mine Ltd.'s **Aley** niobium-bearing carbonatite proposed mine (see section 6.1.2.). In 2018, an early exploration project **Wicheeda** (LREE), and a grassroots project, **Pine Pass** (Vanadium) were also active.

7.5.1. Wicheeda (Spectrum Mining Corporation)

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 fl ourocarbonates, ancylite (cerium, lanthanum) and monazite (cerium, lanthanum, neodymium). Minor concentrations of niobium are present as well. A non-NI 43-101 compliant resource estimate concluded that, at an LREE cut-off of 1.00%, the deposit contained an indicated resource of 11.26 Mt grading 1.95% LREE (1.16% cerium, 0.54% lanthanum, 0.24% neodymium, 0.03% niobium, and 0.01% samarium). To start

in late 2018, Spectrum planned to extract a 30 t bulk sample from trenches completed in 2008, and begin a drilling program at up to 51 sites.

7.5.2. Pine Pass (Ethos Gold Corp.)

Ethos Gold began work on its **Pine Pass** black shale-hosted vanadium prospect, exposed along Highway 97. The host rocks are calcareous mudstone and siltstone of the Sulphur Mountain Formation (Middle and Upper Triassic). In 2018, the company completed five hand-dug trenches and continuous rock chip samples in the roadcut. Trench 1 returned grades averaging 0.27% of V_2O_5 over 255 m across strike, and Trench 2 gave grades averaging 0.43% of V_2O_5 over 155 m across strike. The company's immediate plan is to conduct a deep IP survey and continue trenching in an effort to define a drill program.

7.6. Selected coal projects

Exploration for coal in the Northeast Region remained at low levels except at active mine sites. In the North Central Region, Atrum Coal drilled at its **Panorama** anthracite coal project in the Bowser Basin.

7.6.1. Flatbed/Gordon Creek (Colonial Coal International Corp.)

Colonial Coal released a Preliminary Economic Assessment (PEA) on the 'Gordon Creek Project' (part of the Flatbed property) near the Trend mine (Fig. 4). Like Trend, the coal is in the Gates Formation; unlike Trend, the sedimentary units are east of the Cordilleran fold and thrust deformation front and dip gently. Gordon Creek is a proposed underground mining operation within the larger Flatbed property and was estimated to have a Net Present Value (NPV) of \$US650.9 million, which includes metallurgical coal (based on \$US164.80 per t) and PCI coal (based on \$US140.50 per t).These estimates were based on a resource of 111.6 Mt ROM coal and production of 57.4 Mt of clean coal over a mine life of 30 years. The Inferred metallurgical coal resource is 298 Mt.

7.6.2. Huguenot (Colonial Coal International Corp.)

Colonial Coal released a PEA on its **Huguenot** project south of Tumbler Ridge (Fig. 4). As a combined open-pit and underground operation, Huguenot was estimated to have an NPV of \$US1.166 million in metallurgical coal based on \$US172.00 per t, with break-even at \$US 120.00 per t. Measured plus Indicated surface mining resources across three resource blocks (north, middle and south) were reported as 132.0 Mt, and underground as 145.7 Mt. Mine life was projected at 31 years.

7.6.3. Panorama (Atrum Coal Panorama Inc.)

Panorama is a joint venture of Atrum Coal Limited (65%) and Japan Oil, Gas and Metals National Corporation (JOGMEC) (35%). The coal-bearing units lie in the Bowser Basin (Bowser Lake Group, Middle-Upper Jurassic), which straddles the boundary between the North Central and Northwest Regions.

The Bowser Lake Group, in common with the younger coal measures in northeast British Columbia, consists of alternating marine and non-marine deltaic sequences containing multiple coal seams. In 2018, Atrum conducted a drilling program on the Panorama North project, targeting PCI anthracite coal (Fig. 15) in an open syncline for blending to produce metallurgical coal. Eight holes were completed, totalling 1979 m, and seam thicknesses of up to about 4 m were identified.



Fig. 15. Panorama North project, hole PNDH-18-04, 63 m, fractured anthracite coal.

7.7. Selected industrial mineral projects

Apart from the **Giscome** limestone quarry (see section 6.3.1.), the only significant industrial mineral project was in the Northeast Region, where Sil Industrial Minerals began work on its **Sil** project, searching for frac sand resources.

7.7.1. Sil 17-001 to 17-004 (Sil Industrial Minerals Ltd.)

Sil Industrial Minerals Ltd. completed initial exploration in the Northeast Region on a multi-year project in search of frac sand resources, in sandy post-glacial sediments. Accessing exploration sites using existing cutlines and tracks, the proponent plans to complete about 486 shallow holes using a tracked solid stem auger and a reverse circulation drill. In 2018, the company completed 33 holes totalling 200 m.

8. Geological research

In 2018, the British Columbia Geological Survey initiated a three-year, 1:50,000-scale bedrock and surficial geology mapping project in the northern part of the Hogem batholith, north-central British Columbia. During the course of mapping, 17 new mineral occurrences were discovered, mostly porphyry Cu, but also Au- and Cu-bearing quartz veins (Ootes et al., 2019 a, b). Building on work done in 2017 (Milidragovic, et al., 2018), Milidragovic and Grundy (2019) continued a study to better understand the origin of Ni-bearing rocks in the Decar area and the tectonostratigraphy of the Cache Creek terrane. Geoscience BC published the final report of a project focussed on groundwater resources and locating potential aquifers in the Peace region (Morgan and Allen, 2018).

9. Summary

Activity in the Northeast Region expanded in 2018, with Conuma coal reopening the third of the mines that it had purchased in 2016, Willow Creek, and undertaking onlease exploration programs at all three mines. HD Mining International received a Mines Act permit for its Murray River mine project.

Exploration expenditures decreased slightly in the North Central Region as some exploration companies reported difficulties in raising fund for their programs, but that trend is expected to reverse in 2019 as Centerra Gold continues an aggressive exploration program and New Gold begins a major drilling program at its Blackwater project. Major highlights in 2018 include the following.

- Initiation of construction activity in connection with Centerra Gold's Kemess Underground project.
- Completion of the permitting approvals process for HD International Mining's Murray River coal project.
- Large drilling programs both on-and off-lease at Centerra Gold's Mt. Milligan mine.
- Extensive exploration drilling by Kwanika Copper Corporation in the Central zone at the Kwanika Project, and also at Sun Metal's Stardust property a short distance to the north.
- Re-opening of the Willow Creek mine by Conuma Coal Resources Limited, and the initiation of on-lease exploration programs at the Brule, Wolverine and Willow Creek mines.
- Discovery of possible orogenic Au mineralization (AK project) just north of Prince George.

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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 2018 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.

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 Ernst & Young LLP. For the Southeast Region, exploration expenditures were estimated at \$64.5 million and exploration drilling was estimated at approximately 126,400 m (Clarke et al., this volume: Ernst & Young LLP (EY), 2019, in press).

Most drilling focussed on large projects that have been active over the past several years, in addition to exploration drilling at the coal mines in the Elk Valley for mine expansion. Exploration also occurred on many grassroots and smaller early-stage projects, with a number of new projects in the region. Forest fires delayed operations and permitting on several projects, and many struggled to get started before winter; some have been delayed until next spring.

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 (Figs. 1, 2) 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 (Moyie 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 (Fig. 2): 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



Fig. 1. Mines and selected exploration projects, Southeast Region, 2018.

Provincial Overview of Exploration and Mining in British Columbia, 2018. British Columbia Geological Survey, Information Circular 2019-01



Katay

Fig. 2. Geology and physiographic belts of the Southeast Region. Physiographic belts after Nelson et al. (2013). Bedrock units are after Wheeler and McFeely (1991) and Cui et al. (2013) and generalized to highlight temporal and lithological differences in the region. Vulcan tectonic zone is after McMechan (2012).

mines in the Elk Valley, and continues to be an important source 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 2018, 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, 3). With a history of coal mining that dates back to the 1800s, several underground mines were in operation by the early 1900s. Open-pit mining began in 1968, with the introduction of largescale 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. In Q3 of this year, reserves at one of the mines (Coal Mountain) were depleted. The pit operation is now suspended, though the plant and load out facilities remain operational and continue to process coal from the other mines. The main product is metallurgical coal (85%), with some thermal and pulverized coal injection (PCI) coal (15% combined). In 2018, total annual production from the mines in the Southeast Region was approximately 26.2 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. 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. The Plan initially outlined a commitment for constructing five water treatment facilities at the current operating mines, with a projected cost of \$850 to \$900 million during the next five years, and annual operating costs of about \$65 million. However, based on current water quality modelling data and treatment technologies, up to four additional facilities may be required to meet target guidelines after 2023. Teck is engaged in research and development on alternative and passive treatment methods in order to better meet targets.

The first water treatment facility has operated at the Line Creek mine since February 2016, with an additional treatment step that was successfully implemented in 2018. A pilot stage has begun for the second facility at Fording River (Fig. 3), with construction expected to begin next year. An alternative water treatment project, which relies on biological processes in a saturated fill environment, was constructed at Elkview in early 2018 at a total cost of \$41 million. This treatment may be combined with other capping and reclamation techniques on

waste rock piles. Calcite management test work is also ongoing at both **Greenhills** and **Coal Mountain**. Teck is hopeful that a combination of these alternative techniques may either enhance, or replace the need for active water treatment and construction of additional plants.

3.2.1. Fording River (Teck Coal Limited)

The **Fording River** mine (Fig. 3) 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 2018, production at **Fording River** was mainly from their Eagle Mountain pit, with a small amount of production from three pits in their **Swift** expansion area.

West of the current mine area at **Fording River**, the **Swift** expansion area comprises both previously mined (last in the 1990s) and unmined zones of the Fording property, and multiple seams along both limbs of the Greenhills syncline (Fig. 4). The area is along strike and directly north of the **Greenhills** Cougar North project; eventually the two will merge and collectively become the **Swift**. 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**.

Large diameter (9 inch) coring (Fig. 5) for coal quality testing was conducted in new pits, and on Turnbull Mountain, where mine models indicate that relatively thick, gently dipping seams extend into the mountain. Future expansions would include highwall pushback at the Turnbull and Henretta pits, and expansion at their Castle Mountain and Greenhills Ridge areas. Current Proven and Probable reserves are projected to support a further 45 years of mining.

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. 3). Coal seams generally grade in rank from medium-volatile bituminous in the lower parts of the section, to high-volatile-A bituminous at higher intervals. The current annual production capacity of the mine and preparation plant is 5.4 Mt of clean coal. Production is mainly from the Cougar pit area, and Proven and Probable reserves are projected to support another 31 years of mining at the current planned production rate.

The **Cougar Pit Extension (CPX)** project (Fig. 3) 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 (Fig. 4). Exploration drilling in 2018 included both in- pit drilling to update structural and seam thickness models,

Katay



Fig. 3. Coal mines and selected exploration projects, southeastern British Columbia. From British Columbia Geological Survey (2019).

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Provincial Overview of Exploration and Mining in British Columbia, 2018. British Columbia Geological Survey, Information Circular 2019-01

Mine	Operator; Partner	Commodity	Forecast 2018 Production (based on Q1- Q3)	Reserves (as of December 31, 2017)	Resource (as of December 31, 2017)	Comments
Fording River	Teck Coal Limited	НСС	9.0 Mt clean	HCC P: 161 Mt Pr: 221.5 Mt	HCC M: 430.5 Mt I: 938.2 Mt Inf: 787.8 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 45 years of mining at current production rate.
Greenhills	Teck Coal Limited (80%); POSCAN (20%)	НСС	6.1 Mt clean	HCC P: 10.6 Mt Pr: 154.6 Mt	HCC M: 176.6 Mt I: 247.1 Mt Inf: 181.6 Mt	Cougar Pit Expansion (CPX) approved (2016); exploration drilling in expansion areas; coal quality testing; P+Pr reserves are projected to support another 31 years of mining at the current planned production rates.
Line Creek	Teck Coal Limited	HCC, TC	3.8 Mt clean	HCC P: 2.1 Mt Pr: 61.5 Mt TC P: 0.5 Mt Pr: 9.4 Mt	HCC M: 312.1 Mt I: 410.5 Mt Inf: 397.1 Mt TC M: 3.7 Mt I: 3.2 Mt Inf: 1.7 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 & Sumimoto Metal Corp. (2.5%), POSCO (2.5%)	HCC	6.7 Mt clean	HCC P: 7.4 Mt Pr: 286.1 Mt	HCC M: 379.5 Mt I: 164.2 Mt Inf: 245.3 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 42 more years at the current production rate.
Coal Mountain	Teck Coal Limited	PCI	615,000 t clean	na	na	Mineable resource at CMO depleted in Q3 2018; reclamation begun; facilities continue to process coal trucked from Elkview mine; facilities to be placed on Care and Maintenance; Coal Mountain Phase II (CMO2, Marten Wheeler) would utilize 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. 4. Historic workings on Greenhills Ridge, Swift expansion area.



Fig. 5. Large diameter core drill rig, Fording River mine.

and more than 31,700 m in expansion areas. More than 1430 m of large-diameter (9-inch) core was also drilled for bulk sample coal quality and coke strength testing.

3.2.3. Line Creek (Teck Coal Limited)

The Line Creek mine (Fig. 3) 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.

The Line Creek Phase II (LCO2) expansion (approved in 2013) extends operations at Line Creek northward along the Mount Michael and Burnt Ridge North areas, and adds approximately 67 Mt of clean coal to the mine. In 2018, production was mainly from the Burnt Ridge extension (BRX; Fig. 6), North Line Creek extension (NLX), and Mine Services Extension (MSX) pits. More than 8700 m of exploration drilling was completed to further define mine planning and pit



Fig. 6. BRX expansion area, Line Creek mine.

design. Pre-stripping on the early phases of Mount Michael was also completed in 2017, and further exploration and coal quality testing were done in 2018 to prepare for the next phases of mining. 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, and was the first facility constructed under the Elk Valley Watershed Management plan. Work and design changes to improve the treatment process and meet water quality targets continued on the facility in 2018. Design changes at West Line Creek will be implemented in the second facility, at **Fording River**. Under the timelines outlined in the Elk Valley Water Quality Plan, the delay in construction of the second facility resulted in a \$200 million penalty in 2018, though the additional design work is integral to successfully implementing the overall plan.

3.2.4. Elkview (Teck Coal Limited 95%; Nippon Steel & Sumitomo Metal Corporation 2.5%; POSCAN 2.5%)

The **Elkview** mine (Fig. 3) 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 42 years at the current production rate. Production is primarily from the Baldy Ridge and Natal Ridge pit areas. In 2017, the company began pre-stripping on the Baldy Ridge Extension (BRE), which is expected to extend the mine life by a further 25 years. The project will include expansion of their current permit boundary, mining of Baldy Ridge BR3, BR4, BR6, and BR7 pits, expansion of Adit Ridge AR1 and further expansion at Natal Ridge NP2 pit.

In 2018, drilling continued in active pits, as well as in their NP2 and NP3 areas, and included large-diameter core holes for coal quality testing.

3.2.5. Coal Mountain (Teck Coal Limited)

Coal Mountain (Fig. 3) 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. Consolidated Mining and Smelting operated an open pit for a brief period in the 1940s. Open-pit mining began in the 1970s. The historic underground workings at the mine posed challenges to mining operations. Underground tunnels created stability issues for heavy equipment, and timber supports and other materials from the underground workings created challenges for coal quality at the wash plants. In recent years, geophysical techniques were used to map the underground workings and redevelop mine strategies.

Coal Mountain is now nearing the end of its mine life. Truck and shovel operations were suspended in Q3 of 2018, and reclamation of the mine is well underway on the final lifts of the dry stacked tailings facility, and waste dump spoils. The wash plant and load out facilities (Fig. 7) continued to operate and produce product trucked from the Elkview mine. The plant, designed to wash a different quality of coal than the other mines, will be kept operational. This will enable the company to optimize product and coal specifications for different customers. Teck Coal Limited plans to maintain production levels by optimizing and expanding production and facility capacity at their other metallurgical coal mines, despite the 2.25 Mt of lost production from the Coal Mountain shutdown. The recently approved expansion areas at the other four operational mines in the Elk Valley will enable the company to do this. With the possibility of Coal Mountain Phase II (CMO2; Marten Wheeler) starting, the facilities at Coal Mountain (with an annual capacity of approximately 3.5 Mt) will be maintained operational indefinitely.



Fig. 7. Coal Mountain plant.

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 in Cambrian carbonate rocks of the Cathedral Formation that were originally deposited on the edge of the Cathedral escarpment, at the continental shelf edge. 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; Fig. 8) suggest episodic flow of hydrothermal fluids along fault structures of the Cathedral escarpment. 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. The company drilled (650 m, 6 DDH) on their Struna Creek property south of the mine, which is on exploration tenures. Mapping and drilling extended the productive zone and resources along strike.



Fig. 8. Magnesite with pyrite stringers, Cathedral Formation, Mount Brussilof deposit.

3.3.2. Moberly Silica (HCA Mountain Minerals Limited)

HCA Mountain Minerals Limited (Northern Silica Corporation) continued work on their **Moberly Silica** project. The silica deposit is in regionally extensive orthoquartzites of the Mount Wilson Formation (Middle to Upper Ordoviciar; Fig. 9). The formation occurs over a 300 km length along the western portions of the Rocky Mountain fold and thrust belt (Fig. 2). Moberly Mountain is the northern extent of the unit, where it is terminated by a thrust fault, de-cemented, and friable. At **Moberly**, the unit is nearly vertical, about 200 m thick, and extends along strike for 800 m. The deposit was mined from the early 1980s to 2008 for silica sand, glass making, and other

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	Exploration drilling at Struna Creek project (650 m, 6 DDH); MgO, and MgOH; sediment-hosted sparry magnesite.
Moberly Silica	HCA Mountain Minerals Limited (Northern Silica Corp.)	Silica; industrial use silica, frac sand; 082N 001		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)	Updated mine design and haul roads; geological modeling to upgrade the resource; operation redeveloped for frac sand, and processing plant commissioned in 2017 (300,000 tpy capacity); Phase II expansion to 600,000 tpy will cost an additional USD \$15M.
Horse Creek	HiTest Sand Inc. (PacWest Silicon)	Silica; industrial use, aggregate; 082N 043	na	na	Estimated: 3 Mt at 99.5% Silica (1987)	Variety of aggregate and industrial use products; initial phases of public consultation for a silicon metal smelter in Newport, WA, USA.
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).
4J	Georgia- Pacific Canada Limited	Gypsum; evaporitic bedded gypsum; 082JSW009	na; processing stockpiled ore	na	Estimated: 20 Mt	Processing stockpiles; updating mine expansion plans.
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.
Grand Forks Slag	Granby River Mining Company Inc.	Slag/silica; tailings from Grand Forks smelter dumps; 082ESE264	Quarrying for abrasives and roofing granules	na	na	Crushing, screening; environmental monitoring.

Table 2. Selected industrial mineral mines, Southeast Region.

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

industrial uses. In 2011, the company completed feasibility and engineering studies to produce 30-mesh to 140-mesh frac sand for the western Canadian oil and gas industry, and outlined a mine plan with a 35-year mine life. Redevelopment of the current operation began in 2015, and new 300,000 tpy frac sand processing plant was commissioned in 2017, with the potential for expansion to a 600,000 tpy capacity. In 2018, the company mapped, and updated geological models to redefine the zone and resources, and for the next phases of mine planning.

3.3.3. Horse Creek (HiTest Sand Inc.)

At the **Horse Creek** silica mine, HiTest Sand Inc. operates a seasonal quarry in Mount Wilson orthoquartzites. The orthoquartzites are more consolidated than at Moberly, and HiTest Sand Inc. produces industrial-use and aggregate products. The company is also evaluating producing alternative products, including silicon metal. They have begun initial phases of permitting on a silicon smelter facility in Newport, Washington. Operating under the name PacWest Silicon (a



Fig. 9. Ripple marks on upturned bedding of the Mount Wilson quartzite (Ordovician), Moberly silica mine.

subsidiary of HiTest Sand Inc.), the proposed smelter will produce 73,000 tons of silicon metal each year. Metallurgical silicon can be used in steel smelting, aluminum alloys, and to produce photovoltaic solar cells and electronics.

3.3.4. 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 (Butrenchuk, 1991). 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 6.3.1), which received conditional approval through Environmental Assessment in January, 2018.

3.3.5. 4J (Georgia-Pacific Canada Limited)

Georgia-Pacific Canada Limited operates the **4J** gypsum mine and a rail load-out facility southeast of Canal Flats. The deposit is in Burnais Formation evaporites (Middle Devonian). The company has been producing mainly from stockpiled material of the fine fraction for use in agricultural.

3.3.6. 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 also naturally fire-retardant.

3.3.7. Grand Forks Slag (Granby River Mining Company Inc.)

The Granby River Mining Company Inc. operates the **Grand Forks Slag** quarry, producing abrasives and roofing granules from smelter slag. The historic smelter operated between 1900 and 1918, and processed copper-gold ore from the historic Phoenix mine.

4. Placer operations

Placer mines have operated in southeastern British Columbia since the gold rush began in 1864. Although activities were not tracked in 2018, 58 placer projects currently have active Mines Act permits that allow mechanized work, consisting of more than simple hand panning (Fig. 10).



Fig. 10. Placer mining, hand panning during the 2018 Chamber of Mines of eastern British Columbia prospecting course.

5. Proposed mines and quarries

The Southeast Region has four proposed coal mines (Table 3): Michel Coal (North Coal Limited), Crown Mountain (Jameson Resources Limited), Coal Mountain Phase II (on hold; Teck Coal Limited), and Bingay Main (Centermount Coal Ltd.). In addition to the approval of the Kootenay West
mine (CertainTeed Gypsum Canada Inc.) earlier this year, another industrial mineral mine, **Driftwood Creek** (MGX Minerals Inc.), is proposed.

5.1. Proposed metal mines

There are currently no proposed metal mines in the region.

5.2. Proposed coal mines

There are currently four proposed coal mines in the Southeast region in various phases of environmental assessment. Each project must demonstrate how they will meet the guidelines set out in the Elk Valley Water Quality Plan as part of their application.

5.2.1. Michel Coal (North Coal Limited)

North Coal Limited, a wholly owned subsidiary of CoalMont Pty Ltd., entered the pre-application phase of environmental assessment for their **Michel Coal** project in 2015. Since that time, with 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. 3), and submitted a revised project description in September 2018. The expanded plan will give them more flexibility in blending product from different areas to client specifications. The project is expected to produce between 2.3 and 4 Mt annually, with a 30-year mine life.

In 2018, work continued on expanded 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. Exploration drilling focussed mainly on the **Tent Mountain** area, work was completed on a 3D model for resource modeling, and mine planning continued. Drilling 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 (~6:1) strip ratio. The company released an updated NI 43-101 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.

5.2.2. Crown Mountain (NWP Coal Canada Ltd.)

The **Crown Mountain** property (NWP Coal Canada Ltd.), a subsidiary of Jameson Resources Limited, is along strike with **Line Creek** (Fig. 3), 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 their application information requirements (AIR) from the environmental assessment office in April 2018. In June, the company entered into an option agreement with Bathurst Resources Limited who gained a 8% interest in the project, and could become a 50/50 joint venture partner after exercising all tranches in the terms of the agreement, with an investment totaling \$121.5M.

In 2018, the company drilled and completed coal quality testing on bulk samples from large-diameter core. Environmental baseline work also included geotechnical drilling and installation of groundwater monitoring wells. Engineering and process design work also continued on spoil pile design and water treatment to meet water quality guidelines. Jameson Resources is also exploring the use of biological reduction of nitrate and selenium using naturally occurring microbes within waste piles and other passive water treatment techniques with hopes to mitigate the need for active water treatment on site.

The project proposal is for 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 2014, the company completed a resource estimate of 74.9 Mt (Measured+Indicated) and a preliminary prefeasibility study. In 2016, the study was updated with improved economics related to coal pricing and operating and capital expenditure costs. Coal quality test work indicates that approximately 84% of the coal is hard coking coal, the remainder PCI coal.

5.2.3. Coal Mountain Phase II (Teck Coal Limited)

At Teck Coal's **Coal Mountain Phase II** (CMO2; Marten Wheeler) project, the Mist Mountain Formation contains up to 15 coal seams, 1- 8 m thick, with a cumulative average thickness of 75 m on Marten and Wheeler ridges (Fig. 3). The project entered pre-application stages of environmental assessment in September 2014, but was withdrawn in 2015 and put on hold. The project was proposed to replace production and use infrastructure from the **Coal Mountain** mine. Facilities at **Coal Mountain** will be placed on care and maintenance, but maintained in a ready-to-operate state.

5.2.4. Bingay Main (Centermount Coal Ltd.)

Centermount Coal Ltd. is proposing an open-pit mine on the **Bingay Main** property (Fig. 3). The project entered preapplication of environmental assessment in 2013; the company resubmitted the project description in 2017. Environmental baseline studies are ongoing. The mine would produce approximately 1 Mtpy over an estimated 15-year lifespan, with a total resource of approximately 13 Mt of clean coal. At **Bingay**, the coal-bearing Mist Mountain Formation is preserved in a tight, asymmetric syncline in the immediate footwall of a west-dipping thrust fault (Bourgeau thrust). The coal is medium-volatile to high volatile-A bituminous in rank.

5.3. Proposed industrial mineral mines

There are three proposed industrial mineral mines in the region, the **Kootenay West** (gypsum; Certainteed Gypsum Canada Inc.) and **Driftwood Creek** (magnesite; MGX Minerals Inc.) mines. The **Black Crystal** graphite quarry (Eagle Graphite Corp.) is on care and maintenance while the company is focusing on research and development work for their product. Several other small quarries and pits for

Project	Operator (partner)	Commodity; deposit type; MINFILE	Reserves	Resource	Comments
Michel Coal	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)	Drilling (5000 m, 23 holes); environmental and baseline work; drilling of 23 groundwater monitoring wells; 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 Ltd. (Jameson Resources Limited 92%, Bathurst Resources Limited 8%)	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 for 8% with ability to earn 50% with investment of \$121.5 M; drilling (4200 m, 23 holes); Pre-application of EA (2014); Application Information Requirements (AIR) received in April (2018); coal quality testwork; water quality and treatment studies involving passive biological treatment; engineering studies and mine design; 16-year mine life; 1.7 Mtpy.
Coal Mountain Phase II (Marten Wheeler)	Teck Coal Limited	Coal (PCI and TC); open pit and underground; 082GNE006	na	HCC M+I: 173.9 Mt Inf: 7.9 Mt PCI M+I: 6.5 Mt Inf: 0.9 Mt (2015)	Pre-application of EA (2014); Potential of 76.5 Mt; 34- year mine life; 2.25 Mtpy; EA withdrawn in late 2015; project on hold.
Bingay Main	Centermount Coal Ltd.	Coal (HCC); open pit and underground; 082JSE011	na	M: 42.43 Mt I: 52.9 Mt (2012)	Pre-application of EA (2012); resubmitted project description (2017); 13 Mt; 15-year mine life; 1 Mtpy.
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; 400,000 tpy; 43-year mine life; blended product to market specifications.

 Table 3. Selected proposed mines, Southeast Region.

Table 3. Continued.

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 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; updated resources; working on Preliminary Economic Assessment.

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

dimension stone, flagstone, sand and gravel are not covered in this discussion.

5.3.1. 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 is currently 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 42 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 2018, the company focussed on environmental work and modifications to the mine design. Phase 1 construction, with estimated capital costs of \$20 million, is projected for 2019. It will replace production after the Elkhorn mine is depleted.

5.3.2. 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 2016, the company took a 100 t bulk sample from a near surface (<15 m) zone, and released a NI 43-101 compliant resource estimate. They acquired a pilot test mill, which includes a jaw crusher, ball mill, floatation cells, cyclone dewatering equipment, and tailings filtration system. They used the mill to upgrade the bulk sample to a high-purity magnesite

 $(MgCO_3)$ and a silica by-product using reverse flotation techniques. 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. The company continued environmental baseline studies, and drilled step out zones at both the East and West zones.

5.3.3. Black Crystal (Eagle Graphite Corp.)

Eagle Graphite Corp. operates the Black Crystal flake graphite open-pit quarry on Hodder Creek and processing plant 10 km west of Passmore. The property is in the central part of the Valhalla complex (Fig. 2) in the Valhalla dome, a structural complex of upper amphibolite-grade gneisses in Paleozoic rocks of the Kootenay terrane that was 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 m². At the quarry location, the graphitic horizon is 30-40 m thick, immediately underlying the overburden, and dips sub-parallel 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 that averages 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 were produced as by-products during the mining and refining process. In 2018, the company updated the resource estimate with results obtained in their 2016 drilling, and focussed efforts on research and development to upgrade the purity of their product for use in the energy storage industry.

6. Selected exploration activities and highlights

Exploration continued in the Southeast region in 2018 for numerous targets, including base and precious metals, industrial minerals, and coal (Fig. 1; Table 4).

6.1. 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 along the Vulcan low (Höy, 1982; McMechan, 2012; Seabrook, 2015).

6.1.1. Zinger (PJX Resources Inc.)

The **Zinger** property is underlain by Purcell Supergroup rocks (Proterozoic), predominantly quartzites, argillites, and siltstones of the Creston Formation, argillites of the Kitchener Formation, and gabbro sills and dikes. The property is adjacent to the Perry Creek fault, and multiple NW-trending faults hosting sericite-carbonate-quartz alteration, that crosscut NNEtrending folds. Mineralized breccias and tension veins occur within minor folds and structural intersections in the more competent quartzite units. In 2018, PJX Resources Inc. targeted gold in quartz veins with mapping, sampling, and drilling. Grab samples from multiple quartz veins returned anomalous gold assays along a 6 km trend, and are coincident with a 4 x 2 km airborne VTEM anomaly. VLF ground geophysics identified dipping conductors that coincide with soil anomalies at surface, and the company drilled (1224 m, 6 DDH) to test downdip extensions.

6.1.2. Dewdney Trail (PJX Resources Inc.)

PJX Resources Inc. continued mapping and sampling in 2018 at their **Dewdney Trail** property, and identified targets for drilling. Grab samples from a pervasively altered and fractured quartzite returned up to 18 g/t Au. The quartzite, 75 to more than 200 m in true width can be traced for more than 12 km. Heavy mineral stream samples contain angular visible gold. Chemical compositions are fairly consistent, and trace quantities of silver, copper and iron, suggest a single bedrock source that may be associated with felsic intrusive rocks and/ or sericite alteration.

The property is underlain by folded, faulted, and altered Mesoproterozoic sandstones and argillites of the Fort Steele, Aldridge, Creston, and Kitchener formations that are cut by Cretaceous, and possibly Tertiary, felsic to mafic intrusions. The property contains several mineral showings, including: 1) large-tonnage sediment-hosted vein type gold prospects at the Spirit, Tac, and Lewis showings; 2) vein-type prospects at the Jack Leg showing; and 3) skarn and stockwork Cu-Au prospects at the Dew Drop showing.

6.1.3. Gold Shear (PJX Resources Inc.)

In 2018, PJX Resources Inc. entered into an option agreement to acquire 100% in the **Gold Shear** property. 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). A mineralized quartz vein was first discovered on the property in 1990, and assayed 144 g/t Au over a chip sample length of 40 cm. The David shear (BC MINFILE 082FSE108) has since been traced along strike for 1600 m, with mineralized splays. Drilling on the property between 1990 and 1996 intersected a 0.8 m zone that graded 196.69 g/t Au, within weak to moderately conductive sulphides. Several veins have been mapped on the property, and rock sampling in 2018 returned several samples with Au grades over 68 g/t, and up to 193.9 g/t Au. VLF ground geophysics has identified a large conductive target area downdip of the David Gold zone, and below the depth of historical drilling. The company has begun compiling all historical data on the property to better identify the structural controls on mineralization and identify targets.

6.1.4. Gold Hill (American Creek Resources Ltd.)

American Creek Resources drilled at their **Gold Hill** property in 2018, targeting down-dip extensions of mineralization at the historic Midas occurrence (BC MINFILE 082GNW022). The area is underlain by Cambrian quartzites, argillites, and carbonates of the Eager Formation, and Cretaceous felsic (syenite/monzonite) intrusions. Mineralization (galena, tetrahedrite, pyrite, chalcopyrite, and rare visible gold) is bestdeveloped in quartz-iron carbonate-pyrite-sericite veins in north-northeast trending shears and breccias. Locally, syenite dikes and host sedimentary rocks are also silicified and carry disseminated pyrite and galena (Fig. 11). Grab samples have assayed 22.32 g/t Au, and up to 442 g/t Au and 1660 g/t Ag. Drilling (2400 m, 4 DDH) began late in the year.



Fig. 11. Galena and pyrite mineralization, Gold Hill property.

6.1.5. Sheep Creek Gold District (Margaux Resources Ltd.)

Margaux Resources Ltd.'s Sheep Creek Gold District project includes the **Bayonne** and **Sheep Creek** properties, where late Jurassic orogenic 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. On the **Bayonne** property additional mapping, rock sampling, and drilling was carried out. The property hosts several high-grade, steeply dipping gold-bearing orogenic quartz veins in a granodiorite roofpendant of the Bayonne batholith (Mine stock; Middle Jurassic, 171 Ma) that cuts Neoproterozoic argillaceous quartzites and Table 4. Selected exploration projects, Southeast Region.

Project	Operator (partner)	Commodity; deposit type; MINFILE	Resource (NI 43- 101 compliant unless indicated otherwise)	Comments
Alpine	Braveheart Resources Inc.	Au-Ag-Pb-Zn; mesothermal Au and polymetallic veins; 082FNW127, 257, 292	Inf: 268,000 t grading 16.52 g/t Au, using a cutoff grade of 5 g/t (2018)	Mapping; sampling; drilling (1500 m); resampling of historic core; STEINERT ore density sorting testing: a 72 kg run of mine sample was upgraded from 14.7 g/t to 20.3 g/t Au, with 92.8% Au recovery and 32.7% waste rejection, and a 128 kg composite sample was upgraded from 25.4 g/t to 43.2 g/t Au, with 81.3% recovery and 52.1% waste rejection.
Barnes Lake/ Marten	Fertoz International Inc.	Phosphate; upwelling; 082GSE051, 082GNE027	na	Mapping, sampling, environmental baseline studies; application for bulk sample permits.
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.
Dewdney Trail	PJX Resources Inc.	Au; Au-veins; 082GNW094	na	Geological mapping; heavy mineral stream sampling; sampling; following up on heavy mineral stream sediment survey from 2016; angular gold grains indicate grains in stream samples near bedrock source.
Duncan	Rokmaster Resources Ltd.	Zn-Pb-Ag; carbonate-hosted; 082KSE023, 22	na	Mapping; sampling; soil geochemistry; historic drill core results include 14.7 m grading 8.20% Zn+Pb, 13.4 m grading 8% Zn+Pb, and 12.2 m grading 8.31% Zn+Pb; grab sample results up to 23 g/t Ag, 12.5% Pb, and 21.4% Zn; drill permits received late in 2018.
Elko	Pacific American Coal Limited	Coal (HCC, PCI); 082GSE029	M: 19.2 Mt I: 57 Mt Inf: 181.3 Mt (JORC 2015)	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	One tonne sample sent for metallurgical test work; results indicated suitability for medium quality feedstock for metallurgical-grade silicon; sampled 97.8 to 99.9% SiO ₂ ; began drilling late in the year (8 DDH).
Gold Drop	GGX Gold Corp.	Au; alkalic intrusion-associated Au; 082ESE055, 150, 152, 153, 285, 286, 287	na	Rock sampling; trenching; channel sampling; drilling at the C.O.D. (71 DDH, 14,500 m); drill results include: 2.05 m grading 50.1 g/t Au; 1.47 m grading 54.9 g/t Au; and 16.03 m grading 4.59 g/t Au; trenching at the Everest, Gold Drop, Silent Friend, and Ken veins.
Gold Hill	American Creek Resources Ltd.	Au, Pb, Zn, Cu; vein; 082GNW022	na	Drilling (2400 m, 4 DDH); sampling.

Gold Shear/ David	PJX Resources Inc.	Au, Cu, Pb, Zn; vein; 082FSE108	na	VLF ground geophysics; mapping; rock sampling; several grab samples assayed 68 g/t, and up to 193.9 g/t Au; drill targets identified on VLF to test down-dip extensions of the vein, below the level of historic working; historic drilling returned 0.9 m grading 169.96 g/t Au.
Goldsmith	Black Tusk Resources Ltd.	Au, Pb, Zn, Cu; veins; 082KSW088	na	Mapping, trenching, sampling; historic workings and trenches along a 2 km strike length.
Greenwood (Lexington/ Golden Crown)	Golden Dawn Minerals Inc.	Au-Ag-Pb-Zn+/-Cu; Cu-Au-Ag skarns, polymetallic veins, epithermal Au- veins, porphyry; 082ESE041, 42, 32, 45, 20, 130, 116	Golden Crown: M+I: 163,000 t grading 11.09 g/t Au, 0.56% Cu (2016); Lexington: M+I: 372,000 t grading 6.4 g/t Au, 1.05% Cu (2016)	Golden Crown drilling (33 DDH, 3121 m); drill intersections include 1.74 m grading 11.11 g/t Au, 0.23% Cu, 7 g/t Ag; 1.66 m grading 15.20 g/t Au, 1.37% Cu, and 20.1 g/t Ag; 12.3 m grading 3.53 g/t Au, 0.11% Cu; and 6.95 m grading 6.77 g/t Au, 1.18% Cu; surface mapping and sampling. Lexington dewatering and rehabilitation of underground; mapping; rock sampling; results included: 3.9 m grading 13.41 g/t Au, 2.08% Cu; 2.3 m grading 26.67 g/t Au, 1.77% Cu; 1.8 m grading 30.18 g/t Au, 4.93% Cu; 1.4 m grading 22.2 g/t Au, 4.32% Cu; and 2.6 m grading 17.04 g/t Au, 3.42% Cu; surface mapping and sampling.
Irishman/ Panda/DD	Teck Resources Ltd.	Pb-Zn-Ag+/- Cu; SEDEX, polymetallic veins; 082FSE110, 082GSW077	na	Mapping, magnetotellurics, drilling (1 DDH, 1425 m); soil geochemical sampling.
Iron Range	Eagle Plains Resources Ltd.	Pb-Zn-Ag+/-Cu, Au; vein, breccia, IOCG; 082FSE014, 15, 16, 17, 18, 19, 20, 21, 22, 23	na	Mapping, sampling, soil geochemistry, stream sampling, IP geophysics; drilling (2 DDH, 997 m).
Jackpot	Margaux Resources Ltd.	Pb-Zn-Ag+/-W, Au, Mo, Bi; stratiform replacement; 082FSW012, 13, 14, 15, 255, 256	na	Boulders at Big Zinc target grading up to 44% Zn. Re- logged historic core; updated geologic model.
Kena	Prize Mining Corp. (Apex Resources Inc.)	Au-Cu+/-Pb-Zn-Ag; porphyry, Au-veins, polymetallic veins; 082FSW379, 173, 174, 175, 294	Kena: I: 24.89 Mt grading 0.6 g/t Au; Inf: 85.79 Mt grading 0.48 g/t Au	Released results of 2017 drilling (3425 m, 29 DDH); results include Daylight : 0.9 m grading 62.7 g/t Au, 0.5 m grading 20.9 g/t Au, 0.5 m grading 7.36 g/t Au; Toughnut : 0.7 m grading 7.3 g/t, 1.0 m grading 25 g/t Au, and 2.0 m grading 5.58 g/t Au. 2018 drilling (3386 m, 20 DDH) at Toughnut; results include 4.37 g/t Au over 6.0 m and 14.3 g/t Au over 0.84 m.
Koot	MGX Minerals Inc.	Si; silica sandstone; 082JSW025	na	Mapping, sampling, drilling (782 m, 10 DDH); 97.61 to 99.9% SiO ₂ .

Ledgend	Cardero Resources Corp.	Ni, Co, Cu; syngenetic massive sulphide; 082KSE092	na	Airborne magnetic survey, trenching, mapping.
LH	Magnum Goldcorp Inc.	Cu-Ag-Au; subvolcanic, skarn, Au-veins; 082FNW212	na	Drone-survey magnetics; released 2017 drill results including 8.5 m grading 7.10 g/t Au; gold mineralization appears to be associated with pyrrhotite+/-arsenopyrite; drone magnetic survey and orthophotos.
Monroe	Highway 50 Gold Corp.	Pb-Zn-Ag+/-Au, Cu; SEDEX; 082GSW069, 35, 41	na	Drilling (4 DDH; 4000 m) to follow up on 2015-2017 drill programs; encountered fragmental rocks, moderate to intense albitization; bedded pyrrhotite-sphalerite; disseminations and veinlets of sphalerite and galena; thickened isopach sequences within the Aldridge Formation.
Midway	KG Exploration (Canada) Inc.	Au-Cu-Pb-Zn- Ag+/-Mo; Cu- Au-Ag skarn, polymetallic veins, Au-vein, porphyry; 082ESW022, 210, 34, 221	na	Drilling (1420 m; 4 DDH); option agreement with Grizzly Discoveries Inc. to gain 75% interest in 27,346 ha; fulfilled 3 rd year agreement to drill; following up on targets identified in airborne, ground EM and magnetics, geological mapping, sampling, and 2017 drilling; continued mapping and sampling at the Rads claim group.
Rossland Gold	Currie Rose Resources Ltd.	Au+/-Ag,Cu,Pb,Zn; Au-quartz veins; 082FSW093, 195, 102, 135	na	Mapping, sampling, compilation of historic data; community engagement; identified eight target areas; permitting for drilling.
Sheep Creek Gold District	Margaux Resources Ltd.	Au+/-Ag, Pb, Zn; Au-quartz veins, polymetallic veins; 082FSW040, 48, 50, 51, 52, 53, 082FSE030, 31, 34, 25	na	 Bayonne: mapping; drilling (3308 m, 13 DDH); drill intersections of 1.40 m grading 39.43 g/t Au, and 131.2 g/t Ag; 0.88 m grading 16.88 g/t Au, and 60.2 g/t Ag; and 1.14 m grading 10.85 g/t Au, 23.7 g/t Ag; drilling targeted areas below historic mining and stepout. Sheep Creek: mapping; sampling; compilation of historic data into 3D model using lidar acquired in 2017; sampling of historic Reno and Nugget mine dumps (historic grades of 19.2 g/t Au); dump samples sent to research facility to test ore sorting method.
Silvana	Klondike Silver Corp.	Ag-Pb-Zn+/-Au; polymetallic veins; underground; 082FNW050, 13, 082KSW006	na	Rehabilitation of the 4625 portal at the Silvana; phase lexploration program included 80 m of drifting, and drilling (1030 m, 13 DDH); updated their 3D geological model; facility upgrades; environmental monitoring; mill on care and maintenance; environmental baseline work.
Silver Fox	Antofagasta plc (Kootenay Silver Inc.)	Cu-Ag; sediment- hosted copper; 082GSW070, 72, 73	na	Drilling (1 DDH, 500 m); mapping, sampling; three 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.

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, and 3.2% Zn (2013)	Drilling (1983 m; 30 DDH); downhole magnetics; ground geophysics, including resistivity, magnetics, and VLF; processed a 600 t sample using a pilot test mill, with recoveries of ~25.3% of the Au; extension of SIF gold zone.
Tungsten Tailings	Margaux Resources Ltd.	W; tailings; 082FSW010, 9	Estimated: 1.4 Mt grading 0.11% WO ₃ (non-compliant)	Evaluating economic viability to reprocess tailings from historic Emerald mine; 3500 kg sample sent to CRONIMET for testing; 84 samples tested 0.11% WO ₃ ; environmental baseline studies; permitting for 10,000 t bulk sample.
Vine	PJX Resources Inc.	Pb-Zn-Ag+/- Au; polymetallic veins, 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; non-compliant)	Drilling (6000 m; 15 DDH); magnetotelluric survey; geophysical and geological modeling; focus on East gravity anomaly; infilled gravity survey grid; detailed geophysical and geological model; drilling intersected sulphides (pyrite, pyrrhotite, sphalerite) near Moyie fault zone.
Wonah	MGX Minerals Inc.	Si; silica sandstone	na	Mapping, sampling; 98.9 to 99.9% SiO_2 ; quartzite exposed along strike for 850 m, steeply dipping; received permits for drilling and began road construction.
Zinger	PJX Resources Inc.	Ag-Pb-Zn+/-Au; polymetallic veins; 082FSE122, 65	na	Drilling (1224 m, 6 DDH); Geological mapping; East grid soil anomaly approximately 100 x 300 m, with Au ranging from 100 to 4941 ppb; VLF and VTEM; dipping VLF conductors coincident at surface with soil geochemical anomalies.

M = Measured; I = Indicated; Inf = Inferred

limestones of the Horsethief Creek Group. Historic production (1936-1942) was mainly from the Main vein and a splay known as the A vein. The mine produced 81,782 t, at an average grade of 16 g/t Au and 45.9 g/t Ag.

In 2017, the company mapped 10 veins, focusing mainly on the areas between the Main vein, which extends for approximately 1000 m along strike, the A vein (a splay off the Main vein; 550 m strike length), and the Maggie Aikens vein (100 m strike length). Grab sample results include 27.5, 23.3, 18.1, 15.0 and 10.6 g/t Au from the Main vein, and 51.6 g/t Au and 46.6 g/t Au from the Maggie Aikens vein, along with anomalous silver, zinc, lead and tungsten values. Drilling in 2018 (3308 m, 13 DDH) followed up on results from 2017, and focussed on the Main and A veins in areas beneath the historic workings, and step-out areas. Vein intersections included 1.40 m grading 39.43 g/t Au, and 131.2 g/t Ag; 0.88 m grading 16.88 g/t Au, and 60.2 g/t Ag; and 1.14 m grading 10.85 g/t Au, 23.7 g/t Ag. Bulk tonnage results on drilling also included up to 1.14 m grading 10.85 g/t Au, and 23.7 g/t Ag, and copper mineralization increased with depth. The eastern extension of the vein system is splayed and horsetail veinlets occur in a broader zone of alteration and elevated gold mineralization.

The company now also holds 1200 ha of contiguous mineral tenure that includes 60 known veins and 34 past producers at their **Sheep Creek** property. The showings are in a 7 x 1.2 km NNE-trending corridor. Mineralized veins are typically 10 cm to >2 m wide, strike ENE, and are steeply dipping to near vertical. They are concentrated at the crests of folds, and preferentially hosted in brittle units in the metasedimentary package and pre-orogenic intrusions. Historic production from the camp (1899-1951) totalled 736,000 oz Au, 356,000 oz Ag, 377,000 lbs Pb, and 312,000 lbs Zn (with an average grade of 13 g/t Au; Allan et al., 2017; Matthews, 1953).

Drilling identified new zones of mineralization in Cambrian limestones (Laib Formation, Fig. 3) stratigraphically above the main quartzite host units. In 2018, the Margaux compiled historic data into a 3D model using lidar. Surface workings identified on the lidar survey were used to rectify the locations of historic workings, and also identified new workings that had no information. The historic dumps of the Reno and Nugget mines, with historical grades that averaged 19.2 g/t Au (Mathews, 1953) were also sampled. Dump samples were sent to an independent research facility for sensor-based sorting testing to determine if waste rock grades could be upgraded and processed. Their planned drill program was delayed due to forest fires until 2019.

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

KG Exploration (Canada) Inc. (a wholly owned subsidiary of Kinross Gold Corporation) drilled at the Midway project in 2018. As part of an option agreement with Grizzly Discoveries Inc. signed in 2015, Kinross can earn a 75% interest in 27,346 ha in the Greenwood area. The area is just north of their Kettle River mill (1800 tpd), and land package in Washington State. The area is underlain by rocks of the Knob Hill and Anarchist groups (Paleozoic), Brooklyn Formation (Triassic), and Penticton Group syenites and andesites (Eocene). Jurassic, Cretaceous, and Eocene intrusions occur throughout the area. Exploration targets include epithermal gold, skarn, and VMS mineralization in the northern extensions of the Republic and Toroda graben. At Midway, surface sampling and mapping identified additional zones of alteration and veining. A silicified zone at the base of the Eocene unconformity in outcrop contains multiple narrow (to 0.5 m) chalcedonic quartz (+/-quartz breccia) veins in a broader zone of silicification. A soil geochemistry grid was completed on the property, and anomalies coincide with mineralization at surface. Drilling in 2018 (1,420 m, 4 DDH) followed up on alteration and mineralized zones intersected in 2017. Mapping and sampling continued on other claims in the land package, including the Rads claim group, where Triassic sediment-hosted VMS and skarn mineralization occurs along the northern extension of the Republic graben.

6.1.7. Greenwood (Golden Dawn Minerals Inc.)

Golden Dawn Minerals Inc. has been evaluating several historic mineralized areas near their Greenwood project, including the **May Mac**, **Golden Crown**, and **Lexington**. The area is underlain by rocks of the Knob Hill and Anarchist groups (Paleozoic), the Brooklyn Formation (Triassic), and the Penticton Group (Eocene); Jurassic, Cretaceous, and Eocene intrusions occur throughout the area. Mineralization includes: Cu-Au-Ag skarn; Au-Ag epithermal, Ag-Pb-Zn±Au shear hosted, carbonate replacements, stockworks, and breccias, and alkalic porphyry Cu-Au-Ag.

In 2016 and 2017, Golden Dawn acquired assets from Huakan International Mining Inc., including the **Lexington** (Greenwood) mill, and the former Lexington and Golden Crown underground Cu-Au mines, and an additional 11,000 ha from New Nadina Explorations Ltd..

The company continued compiling all historic data to evaluate and identify areas of focus.

Drilling that began late in 2017 at the **Golden Crown** (3121 m, 33 DDH), continued in 2018. Mineralization (pyrrhotite, pyrite, chalcopyrite, arsenopyrite, and gold) occurs in veinlets and as disseminated sulphides in the host rocks (meta-diorite, greenstone and serpentinite). Drill intersections

included: 1.74 m grading 11.11 g/t Au, 0.23% Cu, 7 g/t Ag; 1.66 m grading 15.20 g/t Au, 1.37% Cu, and 20.1 g/t Ag; 12.3 m grading 3.53 g/t Au, 0.11% Cu; and 6.95 m grading 6.77 g/t Au, 1.18% Cu. Surface mapping and sampling identified mineralization 3 km along strike at the JD zone, with chip sample results ranging between 1.8 and 15.8 g/t Au.

Golden Dawn also began dewatering the **Lexington** mine late in 2017, and installed ventilation and rehabilitated some of the workings in 2018. They began mapping and sampling the underground workings to develop a 3D model and characterize the mineralization. Rock chip sample results included: 3.9 m grading 13.41 g/t Au, 2.08% Cu; 2.3 m grading 26.67 g/t Au, 1.77% Cu; 1.8 m grading 30.18 g/t Au, 4.93% Cu; 1.4 m grading 22.2 g/t Au, 4.32% Cu; and 2.6 m grading 17.04 g/t Au, 3.42% Cu. Surface mapping and chip sampling along strike, west of the underground **Lexington** yielded results of 4.5 m grading 14.5 g/t Au.

The Lexington mine produced 5486 oz of Au, 3247 oz of Ag, and 860,259 lbs of Cu from April to December 2008. The ore was processed 17 km away, at the Lexington (Greenwood) mill, a 200 ton per day gravity-flotation facility (Fig. 12). The mill was built in 2007, and is now on care and maintenance; the cost of putting the plant back in operation is estimated at \$270,000.



Fig. 12. The 200 tpd Lexington mill (gravity-flotation) and tailings facility.

6.1.8. 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, and occur within steeply dipping strike-slip and normal faults. The veins postdate the Nelson intrusives, 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.

In 2017, GGX Gold Corp. conducted rock sampling, trenching, channel sampling, and drilling at the C.O.D vein, and near the Gold Drop main vein. The Everest vein was discovered to the southwest of C.O.D., and returned values of 81.8 g/t Au and 630 g/t Ag in grab sample. Drilling continued in 2018 (14,500 m, 71 DDH), on infill locations and extensions of the C.O.D. and Everest veins. Drill results include 2.05 m grading 50.1 g/t Au; 1.47 m grading 54.9 g/t Au; and 16.03 m grading 4.59 g/t Au. The company also mapped, sampled, and trenched at the Silent Friend and Ken veins, to follow up on grab sample results of 6.98 g/t Au and 38.6 g/t Ag, and 4.47 g/t Au and 23.0 g/t Ag from the historic workings. They also trenched extensions of the Gold Drop vein.

6.1.9. Rossland Gold (Currie Rose Resources Inc.)

Currie Rose Resources Inc. entered into an agreement to option approximately 2230 ha at the Rossland Gold property in 2018. The company has begun compiling historical information, and they mapped, sampled, and evaluated geophysics to identify drill targets. The Rossland area is underlain by Upper Paleozoic (Mount Roberts Formation) and Lower Jurassic (Rossland Group, Elise Formation) volcanic and sedimentary rocks, which are variably metamorphosed and cut by Early Jurassic to Eocene intrusive rocks (Rossland monzonite, Rainy Day pluton, Trail pluton, and Coryell suite; lamprophyres and serpentinites). With numerous historical producers, the Rossland camp produced more than 84,000 kg of gold and 105,000 kg of silver between 1894 and 1941. Three main deposit types occur within the camp: 1) coppergold veins with minor lead and zinc in fracture zones; 2) gold veins in high-grade shoots; and 3) molybdenum-tungsten, in fractures of the Trail pluton on Red Mountain (Fyles, 1984). The company identified eight priority targets and plans to drill in 2019.

6.1.10. 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. In 2018, the company released results from a helicopter-supported drill program that began late in 2017 (659 m, 5 DDH) on magnetic anomalies. Intersections included 8.5 m grading 7.10 g/t Au. Gold mineralization appears to be associated with pyrrhotite+/-arsenopyrite, providing conductive targets that are coincident with ground geophysics magnetic anomalies. In 2018, the company expanded their magnetic grid, and obtained orthophotos using drones. The company has plans for further follow-up drilling in late 2018.

6.1.11. Goldsmith (Black Tusk Resources Inc.)

Black Tusk Resources Inc. optioned in on the Goldsmith property in 2017, and began exploration work on the claims. The property is underlain mainly by mafic volcanic rocks (chlorite schist, greenstone) and argillaceous metasedimentary rocks of the Lardeau Group (lower Paleozoic). The strata are variably altered (chlorite+/-sericite+/-quartz-carbonate) and contain from 5-40% carbonate. Historic mine workings and trenches occur in areas of quartz veining, over a 2 km strike-length on the property. Grab samples from these workings assayed up to 29.89 g/t Au. In 2018, Black Tusk compiled historic information on the property and reprocessed airborne electromagnetic and magnetic data from 2006. Linear anomalies appear coincident with the geologic grain of the area, while several features also crosscut the structural grain. The company mapped, sampled, and trenched along an 800 m mineralized corridor. Sulphides and local visible gold (Fig. 13) occurs in quartz veins in a shear system.



Fig. 13. Visible gold in quartz veinlet, Goldsmith property.

6.2. 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.

6.2.1. Vine (PJX Resources Inc.)

PJX Resources Inc. continued drilling in 2018 at the Vine property, conducted magnetotelluric surveys, and updated their geological-geophysical model. The property lies immediately north of the Moyie fault, a northeasterly trending structure in the Vulcan tectonic zone (Fig. 2), and a small north-trending graben. The property 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). Drilling in 2017 and 2018 mainly focussed on the East Gravity zone, which is more than 180 m thick, 400 m wide, and extends for more than 700m along the Moyie fault zone. Right-lateral oblique thrust movement along the fault has folded sequences that include: a silicified and sericite altered breccia that is locally cut by massive iron sulphide veins; phyllitic sedimentary rocks that contain disseminated pyrite, pyrrhotite, sphalerite, and chalcopyrite; and a chloritized and silicified zone that contains disseminated and massive sphalerite in veins and veinlets. The thick package of hydrothermally altered sedimentary rocks is typical of distal SEDEX mineralization in the Belt-Purcell basin, but the disseminated sulphides encountered to date are insufficient to account for the gravity anomalies. A 3D magnetotelluric grid completed over the East anomaly late in the year highlighted a conductive zone that correlates with the gravity high. The company updated their 3D model and further constrained drill targets for January, 2019.

6.2.2. Monroe (Highway 50 Gold Corp.)

Highway 50 Gold Corp. drilled 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; Lydon, 2010).

The company has been drilling since 2015, as a follow up on geochemical soil anomalies and geophysics, with an additional four holes (4000 m) in 2018. 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.

6.2.3. Irishman/Panda/DD (Teck Resources Ltd.)

Teck Resources Ltd. continued work on their properties in the Purcell anticlinorium. The company has optioned surrounding claims for SEDEX mineralization and has the option to acquire 75% of the nearby **DD** property from PJX Resources Inc. 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. In 2018, the company

continued mapping and sampling work on their properties, and drilled (1425 m, 1 DDH) on a magnetotelluric anomaly at the **DD** late in the year.

6.2.4. Silver Fox (Antofagasta plc)

Antofagasta plc entered into an option agreement with Kootenay Silver Inc. to acquire 80% interest in the Silver Fox property. 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. In 2018, Antofagasta followed up on their 2017 work with additional mapping, sampling, and ground geophysics, and drilled one hole (500 m). Grab samples include grades up to 0.55% Cu, 14 g/t Ag, and 0.208 g/t Au.

6.2.5. Iron Range (Eagle Plains Resources Inc.)

The Iron Range property consists of 70,472 ha over a deep-seated regional fault (Iron Mountain fault) in the Purcell anticlinorium. The Aldridge Formation hosts Ag-Pb-Zn±Au,Cu mineralization along the Iron Mountain fault zone, which consists of a number of north-trending faults along a 90 km strike length. Along the fault zone are brecciation, tourmalinization, albitization, fragmental rocks, and intense hydrothermal alteration, including: chloritization, silica flooding and replacement, hematite-magnetite-albite, sericite-carbonate overprinting and intense argillic alteration. The property is also underlain by felsic intrusive rocks. Some showings display hematite, albite and chlorite, and characteristics of precious metal enriched iron oxide copper gold (IOCG) mineralization (BC MINFILE; Duncan, 2014). The company has identified three main target zones: the Talon/Canyon, O-Ray, and Car. In 2018, Eagle Plains Resources Inc. drilled two diamond drill holes (997 m) to test IP anomalies, and down-dip extensions of surface mineralization The holes returned several intersections of anomalous but not economic Au-Ag.

6.2.6. 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 past-producing mines. The company released a NI 43-101 resource estimate in 2013 based on 152 holes that were drilled between 2007 and 2008 at three main zones (Broadview, Great Northern and True Fissure; Fig. 14). The Thor property lies at the northern end of the Kootenay arc (Fig. 2), and is underlain by a thick succession of folded and faulted sedimentary and volcanic rocks of the Badshot Formation and Lardeau Group.



Fig. 14. Drill core, Thor property.

Stratiform sulphide mineralization (Ag-Pb-Zn-Au-Cu) predates folding and faulting and is interpreted as primary, possibly of volcanogenic massive sulphide origin. Parallel horizons of massive and disseminated galena, chalcopyrite, pyrite, and sphalerite 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 2018, the company continued drilling (1983 m, 30 DDH) southeast of the Great Northern zone, as a follow up to their 2016 drilling, which encountered stacked zones of mineralization, and step out mineralization. Each hole was surveyed using downhole magnetics. They also conducted resistivity, ground magnetics, and VLF surveys over portions of the property to better define structures and identify new targets. Surveys identified an extension to the northwest of the SIF zone with quartz vein and iron-oxide alteration similar to SIF. The company also processed a 600 t sample from the SIF zone using a pilot plant to test gold grades and recovery methods. In the field, it was estimated that the plant was only able to recover 25.3% of the gold as a result of a loss of the finer fractions and inefficiencies of using a hammer mill. Future work would include the use of a ball mill to obtain a finer grind size and improve recoveries by liberating more gold. The company has applied for a 10,000 t bulk sample permit, and began collecting environmental baseline data and information required for permitting. The company also plans to update their geological model and update the resource with results from 2018.

6.2.7. 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 quartz-carbonate veins, and as replacements in Slocan Group limestones. Klondike's holdings include the Sandon, Hewitt, Silverton Creek, Cody Creek, Payne, and Jackson Basin camps, and the Silvana, Wonderful and Hinckley past producers. 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).

In 2017, the company began rehabilitating the 4625 portal at **Silvana**, and the 5480 and 6100 portals at the Carnation, in preparation for further underground work. In 2018, the company upgraded rock bolts, began phase 1 of drifting (80 m), and underground drilling (1030 m, 13 DDH) to test unmined zones. 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 mill at Sandon is a 100 tpd flotation mill that operated at an average rate of 40 tpd has been on care and maintenance since 2003.

6.2.8. Tungsten Tailings (Margaux Resources Ltd.)

Margaux Resources Ltd. continued work on their **Tungsten Tailings** project, where they are evaluating the potential for recovering metals from tailings of the historic Emerald tungsten mine with concurrent site remediation. The historic mine operated from 1942 to 1943, and intermittently until 1973. The amount of tailings is currently unknown, but historic records document 1.077 Mt averaging 0.86% WO₃, and up to 1.45 Mt averaging 0.76% WO₃ with mill recovery rates of about 82% (BC MINFILE; Lawrence, 1974). The mine produced from a garnet-pyroxene skarn in the Truman Member (Laib Formation; Cambrian) at the contact with Nelson intrusions (Jurassic).

In 2017, Margaux Resources Ltd. sampled separate areas of the tailings facility, and a total of 84 samples assayed an average of 0.11% WO3. They entered into an agreement with CRONIMET Mining Processing AG, and shipped approximately 3500 kg of material to their lab for testing, to characterize the tailings and determine processing options. Margaux is also in the application process for a 10,000 t bulk sample and on-site pilot processing facility to further test the economic viability of the project. Margaux has partnered with the Salmo Watershed Streamkeepers Society, which is a charitable, non-profit community-based organization focussed on stewardship and awareness of the Salmo River watershed. They hope to showcase the tailings project as an opportunity to generate revenue from industrial activities, while also benefiting the environment, and are drawing on the organization for expertise in collecting environmental baseline data.

6.2.9. Jackpot (Margaux Resources Ltd.)

Margaux Resources Ltd. continued mapping and sampling at the **Jackpot** property. The property is underlain by folded dolomitized limestones of the Reeves Member of the Laib Formation (Lower Cambrian). The Jackpot orebodies are currently thought to be Kootenay arc-type carbonate-hosted syngenetic zinc-lead deposits. Historic showings and workings on the property include two exploration drifts (1858 m; two levels), and 143 surface and underground drill holes.

In the northern part of the property, discontinuous pods and lenses of high-grade zinc oxide mineralization occur at the Big Zinc target in boulders along the 'Oxide fault', with grades of up to 16.3% Zn over 5.8 m reported, and grab samples up to 44% Zn. The boulders are interpreted to be displaced from their bedrock source, and enriched through surface weathering processes. Mapping also identified laminated sulphides in the Active Formation (Ordovician). The company re-logged historic core and continued compiling all historical data into a 3D model.

6.2.10. Kena-Daylight (Prize Mining Corp.)

Prize Mining Corp. entered into two separate option agreements in 2017, to acquire an 80% interest in the Kena and Daylight gold-copper properties (20% owned by Apex Resources Inc.), and 100% of the adjoining Toughnut claims. The area is underlain by sheared and highly schistose augite basalt flows and subvolcanic intrusions of the Elise Formation (Rossland Group), and Silver King intrusions (Late to Middle Jurassic). Porphyry style gold and copper-gold mineralization is low grade, bulk tonnage. In addition, bonanza-grade gold mineralization has four distinct settings: a high-grade corridor, associated with volcanic and intrusive rocks; volcanicintrusive contact areas; bonanza shoots; and bulk tonnage haloes around shoots. Northwest-trending shears also host quartz veins with sulphides. Shear-zone mineralization occurs as vein, stockwork, and porphyry-style Au and Au-Cu. Historic production includes the Starlight, Victoria, Daylight, and Great Eastern mines, which operated intermittently from 1937 to 1949 and produced mainly gold, silver, and copper.

In 2017, the company mapped, sampled, trenched, and conducted ground-based magnetic and VLF surveys to identify targets. Late in the year, they drilled at the Toughnut (1730 m, 11 DDH) and Daylight (2695 m, 18 DDH), and they released results in early 2018. Mineralization at the Daylight occurs within vuggy quartz-carbonate veins and swarms, and in altered intervals of the Silver King porphyry (Jurassic) and mafic volcanic rocks. High-grade intervals in veins (quartz+pyrite+chalcopyrite) included intersections of 0.9 m grading 62.7 g/t Au, 0.5 m grading 20.9 g/t Au, 0.5 m grading 7.36 g/t Au, and low-grade intervals of up to 74.28 m grading 1.09 g/t. At the Toughnut, high-grade mineralization occurs in sheeted quartz veins and sulphide mineralized shears at contacts between the porphyritic intrusions and mafic volcanic rocks. Results include 0.7 m grading 7.3 g/t, 1.0 m grading 25 g/t Au, and 2.0 m grading 5.58 g/t Au. The company

followed up in 2018 with further drilling at the **Toughnut** (3386 m, 20 DDH) across an area of 1000 x 450 m in the Silver King shear system targeting the Gold Eagle showing, where mineralization extends for a strike length of more than 750 m, and the Toughnut Crown Grant workings, where historical grab samples returned up to 32.8 g/t Au, 212.5g/t Ag, 2.6% Pb, and 5.9% Zn from quartz veins in volcanic host rocks. Results from the 2018 drilling include 4.37 g/t Au over 6.0 m and 14.3 g/t Au over 0.84 m.

6.2.11. Alpine (Braveheart Resources Inc.)

At the **Alpine** property, Braveheart Resources Inc. continued to follow up on their 2017 exploration program. The property is underlain by the Nelson intrusions (Jurassic to Cretaceous), with mineralization (Au-Ag-Pb-Zn) in shear-hosted mesothermal quartz veins. Numerous small adits exist on the property, and intermittent production from the historic Alpine mine from 1915 to 1988 totalled 16,810 t containing 222 kg Ag, 356 kg Au, 49,329 kg Pb, and 17,167 kg Zn (BC MINFILE). The 2017 drill program tested the extension and continuity of vein, with drill intersections of up to 1.6 m grading 33.6 g/t Au. Historic core from 1989 drilling was also re-sampled. The helicopter-supported drill program in 2018 (1500 m), was to further test zones of extension. A NI 43-101 compliant resource estimate was released early in 2018, with an Inferred Resource of 268,000 t, grading 16.52 g/t Au, using a cut-off grade of 5 g/t.

Material from the **Alpine** mine was also sent to STEINERT US Inc. in Walton, Kentucky, to test a density ore sorting method and determine if material could be upgraded on site before trucking and processing. A 72 kg run of mine sample was upgraded from 14.7 g/t to 20.3 g/t Au, with 92.8% gold recovery and 32.7% waste rejection, and a 128 kg composite sample was upgraded from 25.4 g/t to 43.2 g/t Au, with 81.3% recovery and 52.1% waste rejection.

6.2.12. Duncan (Rokmaster Resources Corp.)

The **Duncan** property has been intermittently explored since the 1950s. The property is along the Kootenay arc (Fig. 2), and 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, tabular bodies, separated by high-angle fault zones, on the east limb of the Duncan anticline.

In 2017, Rokmaster compiled historic data and re-sampled historic drill core. Results include 14.7 m grading 8.2% Zn+Pb, 13.4 m grading 8% Zn+Pb, and 12.2 m grading 8.31% Zn+Pb. Additional mapping, soil geochemistry and rock sampling was done on the property in 2018 across an area of 4.5 km,

and to the south of the planned drill program. Elevated silver, lead, and zinc anomalies occurred over a distance of 1.3 km. Elevated grab sample results up to 23 g/t Ag, 12.5% Pb, and 21.4% Zn were returned from an area of recent logging. The company also conducted environmental baseline work, and drill permits were received late in the year.

6.2.13. Ledgend (Cardero Resources Corp.)

Cardero Resources Corp. optioned in on five nickel-cobalt massive sulphide prospects as part an agreement totalling 8,000 ha in the Kootenay region, and continued to work on their main project at the Ledgend in 2018. The property is underlain by highly deformed metamorphic rocks of the lower Index Formation (Lower Paleozoic), including black, carbonaceous and calcareous phyllite, argillaceous limestone, minor quartzite and mica schist. Structural and lithological trends are oriented generally north-northwest with abundant evidence of isoclinal folding and polyphase deformation. Mineralization in interpreted as syngenetic, and occurs locally as a manganiferous-rich exhalite with banded metacherts, nickel-bearing massive sulphides and lesser values of cobalt, copper, zinc, and gold. Selected samples have assayed from 0.3 to 0.75% Ni and 0.06 to 0.9% Co. Talc-tremolite schists, listwanites, silicified zones of chromium mica (fuchsite), and spessartine (manganiferous) garnets occur locally.

In 2018, the company continued mapping and sampling on the property. Chip samples include 4 m grading 0.22% Ni and 0.028% Co at the discovery showing, and 0.84% Ni, 0.025% Co in the central showing. Two soil geochemistry grids identified several northwesterly trending linear anomalies that are interpreted to be folded repetitions of the mineralized horizon. The company completed a 90 line-km drone airborne magnetometer survey over the North soil grid and to the west. They also trenched (775 m) three targets identified on the North soil grid, and located disseminated oxides after sulphides in interlayered actinolite-tremolite and talc-carbonate schists. These are interpreted as the altered remnants of high Ni-Co ultramafic rocks that cut calcareous sedimentary rocks, and likely host and source the mineralization. XRF analysis highlighted anomalous Ni-Cu-Zn, with values averaging >1000 ppm Ni along a strike length of more than 800 m.

6.3. 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.

6.3.1. Koot silica / Gibraltar / Wonah (MGX Minerals Inc.)

In 2018, MGX Minerals Inc. continued to explore their three silica projects, evaluating them for silicon metal potential, and possibly as feedstock for solar panel silicon. At the **Koot silica** property, siliceous quartzite, grit and pebble conglomerate, and sandstones (Cranbrook Formation; Lower Cambrian) outcrop at surface. Drilling in 1981 by Cominco outlined a mineralized

zone approximately 400 m long of high purity quartzite, with results of 97.3 to 99.3% SiO_2 in core. The company drilled in 2018 (782 m, 10 DDH), reporting quartzites 36 to 105 m thick with 97.9 to 99.0% SiO_2 .

At the **Gibraltar** property, Mount Wilson Formation quartzite (Upper Ordovician) was quarried for a short time in 1967 (Red Cloud quarry; BCMINFLE 082JSW001). 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% SiO₂, and began an eight-hole drill program late in the year.

At the **Wonah** property, the Mount Wilson quartzite is steeply dipping and exposed along a strike length of 850 m. Geological mapping and sampling was done on the property in 2018; 11 chip samples were assayed between 98.9 and 99.9% SiO_2 . The company received drill permits and began road construction, and plans to drill in 2019.

6.3.2. Barnes Lake/Marten (Fertoz International Inc.)

Fertoz International Inc. continued to work on their phosphate projects in 2018, and have staked additional claims in the Elk Valley and Crowsnest Pass areas. They are targeting phosphoritic beds at the base of the Fernie Formation (Jurassic), and marketing their rock phosphate product as an organic agriculture product that meets the requirements of the Canadian Organic Standards (COS) and the USDA National Organic Program. The company mapped and sampled at their **Barnes Lake** project, where historic grades tested 22.4% P_2O_5 (BC MINFILE). Environmental baseline work is ongoing, and the company is currently applying for bulk sample permits at both their **Barnes Lake** and **Marten** projects. At the **Marten**, phosphoritic beds have been mapped for more than 1200 m along strike, with grades of 24-27% P_2O_5 tested by handheld XRF.

6.4. Selected coal projects

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

6.4.1. 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.

6.4.2. Elko (Pacific American Coal Limited)

Pacific American Coal Limited drilled on their Elko project

in 2018 (8 RC, 1 large-diameter core; 3451 m). Coal quality results are pending, but correlation of geophysical drill logs suggest seam continuity, and will be used to update the geological model. The company began working on the project in 2015, and compiled all the 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 engagement with the First Nations to receive the necessary permits for exploration.

The project is in the Crowsnest Coal field, targeting Mist Mountain Formation coal seams in the McEvoy syncline. Five seams outcrop on the property, with thicknesses of ca. 2.6 to 5.0 m, and quality ranging from hard coking coal to PCI coal. Block modeling indicates potential for a small open cut operation, with potential development of a larger underground operation. In 2015, the company released a JORC resource estimate of 181.3 Mt Inferred+57 Mt Indicated+19.2 Mt Measured, and will use the drill results to update the resource.

7. Geological research

Höy (2017) continued updating maps in the Boundary region and Rioseco et al. (in press) studied the metamorphic evolution of the Purcell Anticlinorium and Kootenay Arc. Work continues on: how to better reduce the amount of chemicals used in cleaning coal by using a water-based jig (Mackay et al., 2017); the Purcell anticlinorium and thickened sections of the Aldridge Formation using seismic and magnetotellurics (Cook, 2017); and carbonatites in the Rocky Mountain Foreland belt (Simandl and Paradis, 2018).

8. Summary

In 2018, exploration and mining continued in the region. Major mine development, expansion plans, and projects in the East Kootenay coalfields continue to advance. The reserves at 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 is expected to begin in 2019. Exploration for SEDEX-style base metals continued in the Purcell anticlinorium, and for precious and base metals throughout the region. There was an increase in exploration for industrial minerals such as silica, which are targeting grades suitable for the production of silicon metal. A silicon smelter proposed at Newport, Washington to process product from mines in the Southeast Region is entering the beginning stages of public consultation and environmental assessment. Overall, exploration activity and spending in the region was increased relative to 2017. Several drill programs continued late into the year throughout the region because of late financing, permitting delays and closures due to forest fires, and some programs were postponed until 2019.

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Exploration and mining in the South Central Region, British Columbia

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1. Introduction

With five major mines, the South Central Region is currently the most productive copper mining district in Canada. In addition, an underground gold mine re-started 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 70 exploration projects were tracked in 2018, although this is a minimum because not all exploration work is recorded, and 2018 work that must be recorded for regulatory compliance is not necessarily reported in the calendar year.

Exploration expenditures for the region are estimated at \$56.0 million; exploration drilling is estimated at 186,600 m (Clarke et al., this volume; Ernst & Young LLP (EY), 2019, in press).

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 midPaleozoic 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 alkaline 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 occurrences, and the Harper Creek 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, in the south, assemblages of oceanic rocks (Tempelman-Kluit, 1989). The Mesozoic rocks are represented mainly by Middle to Upper Triassic volcanic and sedimentary rocks of the Nicola Group, together with abundant Upper Triassic to Lower Jurassic calc-alkaline to alkaline intrusions (Preto, 1977, 1979; Mortimer, 1987; Panteleyev et al., 1996; Schiarizza et al., 2013). The Nicola Group consists mainly of volcanic and volcanic-derived sedimentary rocks, but also includes 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 calc-



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alkaline volcanic rocks with substantial amounts of rhyolite and dacite (Mortimer, 1987; Preto, 1977, 1979). A younger stratigraphic component of Quesnel terrane consists of Lower to Middle Jurassic sedimentary rocks that unconformably overlie the western parts of the Nicola Group (Travers, 1978; Logan and Moynihan, 2009; Schiarizza et al., 2013).

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

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

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

Bridge River terrane occurs in the eastern Coast belt, west of Lytton and Lillooet, where it is partially enveloped by Cadwallader terrane. It is represented mainly by the Bridge River complex, comprising structurally interleaved slivers of chert, argillite, basalt, blueschist, gabbro, serpentinite, limestone, and sandstone (Schiarizza et al., 1997). Both Cadwallader and Bridge River terranes are shown as 'Cache Creek affiliates' on Figure 1.

Stikine terrane is a mid-Paleozoic to Middle Jurassic arc terrane that is markedly similar to Quesnel terrane, and forms a predominant component of the Cordillera in central and northern British Columbia. It is represented in the northwestern part of the South Central Region by a few scattered exposures of volcanic and sedimentary rocks correlated with the Hazelton Group (Upper Triassic to Middle Jurassic; Tipper, 1959, 1969).

Younger stratigraphic units overlap older terranes and cover large parts of the region. These units include: Upper Jurassic to Upper Cretaceous siliciclastic rocks of the Tyaughton-Methow basin, which overlap Cadwallader and Bridge River terranes in the eastern Coast belt (Schiarizza et al., 1997); and mid-Cretaceous arc volcanic rocks of the Spences Bridge Group, which form a northwest-trending belt that overlaps Quesnel and Cache Creek terranes in the Merritt-Lillooet area (Monger and McMillan, 1989), and continues westward across the Fraser River where it overlaps Cadwallader and possibly Stikine terranes (Mahoney et al., 2013). Eocene volcanic and subordinate sedimentary rocks (e.g., Kamloops Group, Penticton Group, Princeton Group) are predominant in some locations. Neogene basalt of the Chilcotin Group overlaps Quesnel, Cache Creek, Cadwallader and Stikine terranes throughout much of the central part of the region (Dohaney et al., 2010). Granitic plutons, ranging from late Middle Jurassic to Eocene, occur throughout the region and, in some cases, are responsible for significant mineralization (e.g., **IKE, New Prosperity**).

3. Mines and quarries

The region produces copper, molybdenum, gold, and silver from five large mines, gold from a small mine, and a variety of industrial minerals (limestone; bentonite; zeolite; diatomaceous earth; high-alumina shale; precious 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 six 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** mines) and three major copper-gold mines (**Mount Polley**; **New Afton** and **Copper Mountain**). The region hosts one operating precious metal mine, **Bonanza Ledge**.

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 cementedfill operation below the existing pit. They mined 120,000 t as of December 2018 at a diluted grade of 6.65 g/t Au. Initial life of mine is a planned 3.5 years at 150,000 tpy, but there is exploration potential. Ore is trucked to Barkerville's QR mill, which is permitted for up to 875 tpd. They report throughput up to 800 tpd and 91.6% recovery, which may improve with recommissioning of a gravity circuit.

Two types of mineralization are of interest: 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% and Mitsubishi Materials Corporation 25%)

The **Copper Mountain** copper-gold mine (Fig. 1; Table 1), has been producing since August 2011. In the first nine months of 2018 they mined 54,060,000 t, including 16,159,000 t ore. Mill throughput was 10,661,000 t at a feed grade of 0.31% Cu and 79.4% recovery. Holbek et al. (2015) described the deposit

 Table 1. Metal mines, South Central Region.

Mine	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2018 Production (based on Q1- Q3)	Reserves	Resource	Comments
Bonanza Ledge	Barkerville Gold Mines Ltd.	Au; Au quartz veins; 093H 140	120,000 t at 6.65 g/t Au diluted (as of December)	na	M: 264,000 t 7.3 g/t Au I: 508,300 t 6.2 g/t Au Inf: 173,400 4.6 g/t Au	Long hole and cemented rock fill.
Copper Mountain	Copper Mountain Mining Corporation 75%, Mitsubishi Materials Corporation 25%	Cu, Au, Ag; porphyry Cu- Au, alkalic; 092HSE001	80 Mlb Cu 27,500 oz Au 300,000 oz Ag (management's guidance)	P+Pr: 210,079 Kt 0.26% Cu, 0.08 g/t Au, 0.89 g/t Ag	M+I: 322,755 Kt 0.26% Cu, 0.08 g/t Au, 1.05 g/t Ag Inf: 112,339 Kt 0.21% Cu, 0.08 g/t Au, 0.58 g/t Ag	Resources inclusive of reserves. Excludes New Ingerbelle- M+I: 195,647 Kt 0.26% Cu, 0.16 g/t Au, 0.50 g/t Ag Inf: 93,459 Kt 0.23% Cu, 0.14 g/t Au, 0.43 g/t Ag.
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 (management's guidance)	P+Pr:668 million tons 0.26% Cu, 0.007% Mo	M+I: 1011 million tons 0.25% Cu, 0.008% Mo	Resources inclusive of reserves.
Highland Valley	Teck Resources Limited	Cu, Mo; porphyry Cu+/- Mo+/-Au; 092ISW012, 45	102,500 t Cu, 3266 t Mo (management's guidance)	P+Pr: 589.5 Mt 0.300% Cu, 0.008% Mo	M: 488.4 Mt 0.31% Cu, 0.009% Mo I: 882.6 Mt 0.23% Cu, 0.009% Mo Inf: 382.4 Mt 0.23% Cu, 0.007% Mo	Resources exclusive of reserves.
Mount Polley	Imperial Metals Corporation	Cu, Au, Ag; porphyry Cu- Au, alkalic; 093A 008	15.6 Mlb Cu 39,500 oz Au (management's guidance)	P+Pr: 58.272 Mt 0.33% Cu, 0.30 g/t Au, 0.86 g/t Ag	M+I: 206.22 Mt 0.285% Cu 0.28 g/t Au, 0.67 g/t Ag Inf: 7.519 Mt 0.308% Cu, 0.24 g/t Au, 1.66 g/t Ag	Reserves in 5 zones. Resources inclusive of reserves.
New Afton	New Gold Inc.	Au, Ag, Cu; porphyry Cu- Au, alkalic; 092INE023	55,000- 65,000 oz Au, 75-85 Mlb Cu (guidance) 64.3 Mlb Cu, 58.551 Koz Au, 200 Koz Ag (Q3 actual)	P+Pr: 54.867 Mt 0.61 g/t Au, 2.0 g/t Ag, 0.78% Cu	M+I: 58.038 Mt 0.63 g/t Au, 2.1 g/t Ag, 0.76% Cu Inf: 15.253 Mt 0.39 g/t Au, 1.3 g/t Ag, 0.41% Cu	A, B and C zones + HW lens resources. Resources exclusive of reserves.

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

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as a structurally complex, alkalic porphyry Cu-Au system with mineralization mainly in Nicola Group (Triassic) volcanic rocks with subordinate amounts in coeval intrusive rocks. Mineralization shows strong vertical continuity.

An exploration program at the mine site continued in 2018 with four holes in the east wall of Pit 3. Northwest of current mining at New Ingerbelle, a second phase of drilling included 10,616 m in 29 holes. The Measured and Indicated resource estimate for New Ingerbelle stands at 151.3 Mt 0.29% Cu and 0.18 g/t Au applying a 0.16% Cu cut off or 195.6 Mt 0.26% Cu and 0.16 g/t Au applying a 0.12% Cu cut off. A base case preliminary economic assessment indicated favorable economics using the existing mill.

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

The **Gibraltar** copper-molybdenum 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. In 2013, the mine completed its first full year of operation after extensive modernization, which included expanding mill capacity to 85,000 tpd. Part of the modernization plan was building a separate molybdenum circuit. Gibraltar mined 83.1 Mtons in the first nine months of 2018 and milled 23 Mtons for 99.4 Mlbs Cu, 1.64 Mlbs Mo.

Ore comes from five pits (Connector, Gibraltar, Granite, Extension, and Pollyanna), but not all operate at all times. The deposit is in the Granite Mountain batholith (Upper Triassic; see van Straaten et al., 2013) in a fault-bounded section of Nicola Group sedimentary and volcanic rocks (Quesnel terrane; Schiarizza 2014, 2015).

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 (Fig. 2). In the first nine months of 2018 it milled 36.964 Mt at a Cu grade of 0.23% and recovery of 78.9%. Management's projection is for 100 to 105 Mt Cu and 7.7 Mlb Mo in concentrate for the full 2018 year.

Following ground geophysical survey and drilling programs

that started in 2012, Teck has continued to explore targets near the past-producing Bethlehem mine, the Valley pit, the southern end of the Lornex pit, and the Jericho zone on the northeast edge of the Highmont pit. Teck now proposes to extend mining to the past-producing Bethlehem deposit and an application for a first phase of development is under review with the Ministry of Energy, Mines and Petroleum Resources. Teck has defined about 100 Mt of ore at Bethlehem, which would feed the 140,000 tpd mill. Exploration began late in 2017 between the Highmont and Lornex pits and several km to the east of current operations at their Athena target area.

All mineralization at Highland Valley is 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)

Because of a labour disruption, mining was suspended From May to August at the **Mount Polley** copper-gold-silver mine (Fig. 1; Table 1), and mill feed came from low-grade stockpiles. The 2018 target is 15.6 Mlb Cu and 39,500 oz Au, about 87% of the target set earlier in the year. The Mount Polley mill processes approximately 16,800 tpd and the mine currently has a projected life to 2026. In January 2019, management announced mining would be suspended due to low metal prices.

The alkalic intrusive complex (Upper Triassic) at Mount Polley has at least eight discrete mineralized zones that have contributed to previous production or resource calculations. 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). In mid-2015, the company installed a 14,000 tpd mill. In the first three quarters of 2018 the mine produced 58,551 oz Au, 0.2 Moz Ag, and 64.3 Mlb Cu. The mine is on target to meet the high end of management's 2018 guidance of 55,000-65,000 oz Au and 75-85 Mlb Cu. The company is conducting optimization studies on the C-zone, a down-plunge extension of the currently mined B-zone. Satellite targets were drilled from surface elsewhere in the mine lease area. The known



Fig. 2. Highland Valley Copper copper-molybdenum mine. The Valley pit looking southwest from a viewpoint off Highway 97C. Ore is currently mined from the Valley pit and Lornex pit to the south. The past-producing Bethlehem pit (to the east, out of view) is a proposed expansion area.

New Afton deposits form a high-grade keel beneath the pastproducing Afton open-pit mine, an alkalic porphyry in the Iron Mask batholith (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 and other industrial uses. 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. Mount Polley (Craigmont Industries Ltd.)

In January 2014, Craigmont Industries Ltd. started producing magnetite from their recovery plant at the **Mount Polley** mine. Operations stopped in August 2014, due to the tailings dam breach. Poor markets have delayed its restart. The plant captures magnetite from the mine tailings stream and produces a dense media used for coal washing.

3.2.6. 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

3.2.7. 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 **Zeotech/ Bromley Creek** zeolite quarry. Zeolite from the quarry has agricultural and absorbent applications. Mining is by Absorbent Products Ltd.

3.2.8. 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, including one that is underground (Wingdam). 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 reviewed by an interagency Mine Development Review Committee (MDRC) chaired by the Ministry of Energy, Mines and Petroleum Resources. Six projects are in this category: Ajax, Bralorne, Harper Creek, New Prosperity, Ruddock Creek, and Spanish Mountain (Fig. 1; Table 3).

6.1. Ajax (KGHM Ajax Mining Inc.)

The **Ajax** porphyry copper-gold project is owned by KGHM Ajax Mining 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 alkaline intrusive complex. A revised feasibility study

Mine	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2018 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.)	na	Approx. 13.3 Mt in 2002	Typically mines 500,000 t with 60% processes 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. Alternative markets found for 2018.
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	Not producing 2018.
Lady King Basalt	Opal Resources Canada Inc.	Basalt columns; na	Intermittent operation	na	na	Not producing 2018.
Mount Polley Magnetite	Craigmont Industries Ltd.	Magnetite (recovered from tailings); 093A 008	na	na	na	
Nazko	Can Lava Mining Corporation	Lava Rock; Cinder cone; 093B 060	na	na	Historical 45 Mt	1998 resource estimate.
Pavilion	Graymont Western Canada Inc.	Limestone; 092INW081	na	na	na	On care and maintenance as of June 2016. Developing closure and reclamation plan.
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

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.	Au; Au quartz veins; 092JNE001	na	M+I: 273,123 tons 0.33 opt Au Inf: 363,527 tons 0.22 opt Au, 0.1 opt Au cut- off	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.
Harper Creek	Yellowhead Mining Inc.	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 offer to buy Yellowhead Mining late 2018.
New Prosperity	Taseko Mines Ltd.	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 2018 but a BC Supreme court decision declaring a work permit valid, was appealed. Pending the appeal, an injunction preventing work is in place.
Ruddock Creek	Ruddock Creek Mining Corporation (Imperial Metals 50%, Mitsui Mining and Smelting Co. 30%, ITOCHU Corp. 20%)	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 2018. 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: 306.5 Mt grading 0.39 g/t Au, 0.64 g/t Ag Inf: 450.64 Mt 0.28 g/t Au, 0.61 g/t Ag	Project at environmental assessment pre-application stage. Exploration in 2018 included drilling.

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

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

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. The company has not announced plans for the site.

6.2. Bralorne (Avino Silver & Gold Mines Ltd.)

Avino Silver & Gold Mines Ltd. 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 planning 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 the tailings storage facility was raised in 2015 and the impoundment buttressed in 2016. A new water treatment plant was built in 2016, electrical systems upgraded and various retired equipment and buildings removed or demolished. Other engineering and infrastructure upgrades and replacements are ongoing. Within the new permit boundary, exploration is ongoing, including a 28,000 m drill program, airborne and ground geophysics, mapping and structural modelling and geochemical sampling.

6.3. Harper Creek (Taseko Mines Limited)

The Harper Creek copper-gold-silver project is described as a stratiform, disseminated volcanogenic deposit in metamorphosed volcanic and sedimentary rocks of the Eagle Bay assemblage (Devono-Mississippian). Although Yellowhead Mining Inc.'s application for an environmental assessment certificate was accepted in January 2015, the company suspended work on the application later that year. The British Columbia Environmental Assessment Office denied Yellowhead's request for an extension of the suspension time limit and the process terminated in July 2018. In December 2018, Taseko Mines Limited announced an agreement to acquire all outstanding shares of Yellowhead. Proven and Probable mineral reserves stand at 716 Mt grading 0.26% Cu; 0.029 g/t Au and 1.2 g/t Ag (Merit Consultants, 2014). The 2014 feasibility study proposed a 70,000 tpd operation with a mine life of 28 years.

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 November 2013 and has extended its expiry date by five years. In 2017, the British Columbia Ministry of Energy, Mines and Petroleum Resources issued a permit for a detailed site investigation of proposed mine infrastructure. Although a 2018 British Columbia Supreme Court decision would have allowed this work to proceed, opponents of the project have appealed and obtained an injunction preventing the work pending the appeal.

6.5. Ruddock Creek (Imperial Metals Corporation 50%; Mitsui Mining and Smelting Co. Ltd. 30%; Itochu Corporation 20%)

At the Ruddock Creek massive sulphide prospect, Japan Oil, Gas and Metals National Corporation (JOGMEC) funded Imperial's share of a drill program designed to test a deep extension of the V zone, one of several west of the main E zone. The first of three, nearly horizontal holes intersected 21.7 m 16.99% Zn, 3.44% Pb and 2.41 g/t Ag. The project remains in the pre-application phase of environmental assessment. The deposit is described as sedimentary exhalative, Monashee or Broken Hill-type, in marble, gneiss, and calc-silicate rocks. 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. By funding the 2018 program, JOGMEC earns a right to participate.

6.6. Spanish Mountain (Spanish Mountain Gold Ltd.)

The **Spanish Mountain** project had a field program in 2018 including an archaeological impact assessment, metallurgical testing, step out drilling at the Phoenix zone and infill drilling at First zone. Highlight intersections include: 27.43 m 1.76 g/t Au, 67.06 m 0.82 g/t Au, 16.76 m 1.03 g/t Au.

A 2017 updated preliminary economic assessment was based on a 20,000 tpd, 24-year operation focussed on a pit at First zone. Initial capital expenditure was estimated at \$507 million, pre-tax net present value \$597 million (at 5% discount rate) and initial rate of return 22%. Average annual gold production would be 92,000 oz. The objective of the new work was to upgrade some of the inferred resources and investigate the possibility of achieving a higher grade and lower throughput operation with a lower projected capital cost. The project has been in the pre-application phase of environmental assessment since 2011.

7. Selected exploration activities and highlights

In 2018, as in 2017, the largest exploration project in the region was Barkerville Gold's **Cariboo Gold**. Exploration continued for other gold targets, porphyry copper deposits, skarn deposits (copper; tungsten), stratiform base and precious metals, cobalt-bearing veins and industrial minerals (Fig. 1; Table 4).

Project	Operator (partner)	Commodity; deposit type; MINFILE	Resource (NI 43-101 compliant unless indicated otherwise)	Comments
Amarillo	Troubadour Resources Inc.	Cu; porphyry Cu±Mo±Au; 082ENW108	na	Soil geochemistry, 3D IP, diamond drilling (planned 2000 m began December).
Axe	Evrim Exploration Canada Corp. (Antofagasta PLC)	Cu; 092HNE040, 142, 143	I: 39 Mt 0.38% Cu Inf: 32 Mt 0.38% Cu (gold not included)	Mapping, diamond (2113.6 m) and RC (695.3 m) drilling.
BC Sugar	Lithium Corporation	Graphite; crystalline flake graphite	na	Trenching. Results included weak to moderate graphite mineralization; up to 2.62% graphitic carbon.
Big Kidd	Jiulian Resources Inc.	Cu, Ag, Au; porphyry Cu-Au; 092HNE072, 73, 74, 109	na	Ground magnetic survey. Drilling permitted late in 2018.
Bonaparte	WestKam Gold Corp.	Au; Au quartz veins; 092P 050	na	Diamond drilling 591 m in 8 holes.
Brett	Ximen Mining Corp.	Au, Ag; epithermal Au- Ag-Cu, low sulphidation; 082LSW084, 131	na	Metallurgy. A gold recovery batch test of stockpiled material (34 kg) returned a weighted average grade of 4.20 g/t Au.
Cariboo Gold Project	Barkerville Gold Mines Ltd.	Au; Au quartz veins; 093H 140, 139, 19, 6	M+I: 8.1099 Mt 6.1 g/t Au Inf: 12.7312 Mt 5.2 g/t Au	Diamond drilling 123,021 m in 439 holes. Updated resource estimate.
Fox	Happy Creek Minerals Ltd.	W; W skarns; 093A 259, 260, 261, 211	I: 582,000 t 0.826% WO ₃ Inf: 565,400 t 1.231% WO ₃	Geology, geochemistry, updated resource estimate.
FG	Kore Mining Ltd.	Au, Ag; Au quartz veins; 093A 150, 61	M: 5.6 Mt 0.812 g/t Au I: 9.57 Mt 0.755 g/t Au Inf: 27.493 Mt 0.718 g/t Au	Diamond drilling 1077 m.
Frank Creek	Barker Minerals Ltd.	Cu, Pb, Zn, Ag, Au; Besshi massive sulphide Cu-Pb-Zn; 093A 152	na	Geology, geochemistry. Grass roots work on Frank Creek and area properties.
Getty	Getty Copper Inc.	Cu, Mo; porphyry Cu±Mo±Au; 092INE038, 43	I: 114.41 Mt 0.373% Cu Inf: 41.76 Mt 0.275% Cu	Geophysics in 2018. Mo not included in combined Getty North and Getty South resource estimate.
Gold Creek	Kore Mining Ltd.	Au, Ag; Au quartz veins; 093A 127	na	Diamond drilling 940 m in 4 holes. Highlights included 9.0 m grading 5.8 g/t Au including 1.5 m grading 32.2 g/t Au.
Hedge Hog	Surge Exploration Inc.	Cu, Pb, Zn, Co; Cyprus massive sulphide Cu (Zn); 093H 156	na	Geology, geochemistry

 Table 4. Selected exploration projects, South Central Region.

Ike	Amarc Resources Ltd. (Hudbay Minerals Inc.)	Cu, Mo; porphyry Cu±Mo±Au; 092O 025, 67	na	Diamond drilling 3000 m in 5 holes. Results included 138 m grading 0.28% Cu, 0.024% Mo, 2.1 g/t Ag; 222 m grading 0.35% Cu, 0.022% Mo, 2.4 g/t Ag and 147 m grading 0.26% Cu, 0.042% Mo, 1.9 g/t Ag.
Lac La Hache	Engold Mines Ltd.	Cu, Au, Ag, Fe; 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 (5000 m, 10 holes), geophysics, geochemistry. Highlight intersections include 8.8 m grading 3.26% Cu, 0.88 g/t Au, 16.88 g/t Ag, 26.7% Fe at Spout North; 31 m grading 1.14% Cu 0.28 g/t Au, 6.89 g/t Ag, 24.31% Fe at G1 and 58.5 m grading 0.47% Cu, 0.06 g/t Au, 2.18 g/t Ag, 6.07% Fe at Gap.
Little Gem	Blackstone Minerals Ltd.	Co, Au; five- element veins Ni- Co-As-Ag+/-(Bi, U); 092JNE068, 108	na	Diamond drilling (2918 m, 10 holes), geophysics, geochemistry, geology. Initial drill results included 4.3 m grading 1.0% Co and 15 g/t Au and 3.2 m grading 0.8% Co and 4 g/t Au.
Lorn	Cyntar Ventures Inc.	Cu, Mo; porphyry Cu±Mo±Au; 092O 024	na	Rock and soil geochemistry, mapping.
Miner Mountain	Sego Resources Inc.	Cu, Au; alkalic porphyry Cu-Au; 092HSE203, 78	na	Diamond drilling (3000 m, 9 holes), mapping. Drilling highlights include 57 m grading 0.26% Cu and 18 m grading 0.56% Cu.
Moffat	Pacific Empire Minerals Corp.	Au, Ag, Cu	na	RC drilling (383 m, 7 holes), airborne geophysics.
Mont	Leo Lindinger	Bentonite	na	Test pits.
New Craigmont	Nicola Mining Inc.	Cu, Au; Cu skarns; 092ISE035	na	Drilling (RC 1250 m, 66 holes, DD 5000 m 18 holes). Drilling results included 73.6 m grading 1.05% Cu and 100.6 m grading 1.33% Cu.
North Brenda	Bitterroot Resources Ltd.	Au, Ag; Au quartz veins; 092HNE318, 294	na	Diamond drilling: 1361 m in 9 holes.
Princeton Gold	Tasca Resources Ltd.	Au; Au quartz veins; 092HSE262, 263	na	Trenching.
Rabbit North	Tower Resources Ltd.	Cu, Au; alkalic porphyry Cu-Au; 092INE147, 45		Diamond drilling: 790 m in 2 holes. Highlights include 53 m grading 0.32% Cu and 0.22 g/t Au within a larger interval of 288 m grading 0.18% Cu and 0.12 g/t Au.
Rateria	Happy Creek Minerals Ltd.	Cu, Mo, Au, Ag Re; porphyry Cu±Mo±Au; 092ISE199	na	Mapping, rock sampling.

Red Property	Pacific Empire Minerals Corp. (Engold Mines Ltd.)	Cu, Ag, Au; porphyry?; 092P 197	na	RC drilling: 403 m in 8 holes.
Shovelnose	Westhaven Ventures Inc.	Au; epithermal Au-Ag-Cu, low sulphidation; 092HNE309, 308	na	Diamond drilling (5721 m in 16 holes), airborne and ground geophysics. A new discovery was made with results including 17.77 m grading 24.50 g/t Au.
Skoonka Creek	Westhaven Ventures Inc.	Au, Ag; epithermal Au- Ag-Cu, low sulphidation; 092ISW104, 129, 105, 126	na	Airborne geophysics.
Spius	Pacific Ridge Exploration Ltd.	Cu, Mo; porphyry Cu±Mo±Au; 092HNW027	na	Mapping, geochemistry, geophysics.
Treasure Mountain Silver	New Destiny Mining Corp.	Ag, Au, Cu, Zn; polymetallic veins Ag-Pb-Zn±Au; 092HSW066, 117, 092HSE240	na	Trenching.
Tulameen South	Sable Resources Ltd.	PGE, Ni, Cu; Alaskan-type Pt±Os±Rh±Ir	na	Mapping. Grass roots exploration adjacent to reported Pt placer (historical).
Tulox Gold	Sable Resources Ltd.	Au, Cu; intrusion- related Au pyrrhotite veins; 092P 175		Diamond drilling 1322 m in 7 holes targeting blind mineralization. Potential deposit type inferred from geological setting and soil geochemistry.

M = Measured; I = Indicated; Inf = Inferred

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.

7.1.1. Bonaparte (Westkam Gold Corp.)

Westkam Gold Corp. drilled 8 short holes at the **Bonaparte** project, focusing on the Crow vein. They suspended a planned bulk sampling program. In 1994, a 3700 t sample from surface trenches had an average grade of 26.5 g/t Au. In addition to near-surface gold-bearing quartz veins, chargeability anomalies, alteration assemblages, and proximity to Jurassic intrusive rocks suggest porphyry targets on the property.

7.1.2. Brett (Ximen Mining Corp.)

Ximen completed a gold recovery batch test of stockpiled material (34 kg). The sample returned a weighted average grade of 4.20 g/t Au. They are working toward permitting of underground work, starting with re-opening a portal.

7.1.3. Cariboo Gold (Barkerville Gold Mines Ltd.)

Barkerville Gold's multi-target project was the largest in the region in 2018, as it has been for several years. The project included 123,000 m of drilling in 439 holes and an updated resource estimate with 1.6 Moz Au in the Measured and Indicated categories and more than 2 Moz Inferred (Table 4). They describe several styles of orogenic gold mineralization, both vein and replacement. Work on an internal preliminary feasibility study has not been released. In addition to exploration, they are mining the Bonanza Ledge deposit and trucking ore to the QR mill (see above). Their longer term goal is a larger underground operation at Cow Mountain and Island Mountain, with a mill on site.

7.1.4. FG (Kore Mining Ltd.)

Kore Mining combined with Eureka Resources Inc. and became the new owner of the **FG** (formerly Frasergold) and **Gold Creek** properties. They drilled 1077 m at FG late in the year.

7.1.5. Gold Creek (Kore Mining Ltd.)

A four-hole 940 m diamond drilling project at the Camp zone on the Gold Creek property returned a highlight of 9.0 m grading 5.8 g/t Au including 1.5 m grading 32.2 g/t Au.

7.1.6. North Brenda (Bitterroot Resources Ltd.)

Bitterroot drilled below and along strike from Au-Ag bearing sulphide veins exposed by trenching. The drilling encountered anomalous Au, but at values less than at surface.

7.1.7. Princeton Gold (Tasca Resources Ltd.)

Tasca Resources Ltd. obtained high-grade results from trench samples on a quartz vein at the **Princeton Gold** project, including 217 g/t Au over 0.9 m and 99.7 g/t Au over 0.9 m. Prospecting and soil sampling located the target area. Tasca have a permit for drilling. Canarc Resources Corp. signed an option agreement late in the year.

7.1.8. Shovelnose (Westhaven Ventures Inc.)

Westhaven completed 16 holes and more than 5000 m of drilling at **Shovelnose**. Results of the first 10 holes included 17.77 m grading 24.50 g/t Au in the South zone, a 2018 discovery. The 2018 intersections are the first to confirm high grade at depth (Fig. 3). Follow up drilling at the end of the year tested vertical and strike extents of the vein system. In addition to drilling, Westhaven conducted a ground magnetic survey and passive seismic survey. The South zone target originally appeared as a linear magnetic low in 2017. The seismic survey is to estimate overburden thickness in targets areas. Shovelnose hosts epithermal style mineralization in Spences Bridge Group volcanic rocks (Cretaceous).



Fig. 3. Epithermal (ginguro) textures in core from Shovelnose. The dark sulphide bands can host gold and silver mineralization.

7.1.9. Skoonka (Westhaven Ventures Inc.)

An airborne magnetic survey at **Skoonka** and **Skoonka North** is designed to identify structures and structural trends. Skoonka North is approximately 80 km northwest of Shovelnose, in the same belt of Spences Bridge Group rocks. Between the Skoonka and Shovelnose properties, Westhaven holds the Prospect Valley property. Following results at Shovelnose, a subsidiary of Sable Resources Ltd. staked virtually all open ground in the Spences Bridge belt and formed an alliance with Westhaven. Targets are additional epithermal gold veins.

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

New Destiny's **Treasure Mountain Silver** property partially surrounds Nicola Mining Inc.'s Treasure Mountain Silver past-producer. Rock sampling early in the year returned up to 11.3 g/t Au and 14.5 g/t Ag. They followed with trenching in the southeastern part of the property.

7.1.11. Tulameen South (Sable Resources Ltd.)

Sable Resources acquired **Tulameen South** with the purchase of Western Canada Greenfields Group Inc. They conducted preliminary geological work on this grass roots property. Earlier work in this area considered the potential for platinum group element mineralization or possible Ni-Cu-Co-PGE mineralization.

7.1.12. Tulox (Sable Resources Inc.)

The **Tulox** is a grass roots property with a 2.5 km long Auin-soil anomaly coincident with an intrusive contact. The target is intrusion-related gold. The first drill program on the property consists of 7 holes and 1322 m.

7.2. Selected porphyry projects

More than 12 exploration projects focussed on porphyry deposits in 2018. Notable among these was Copper Mountain Mining Corporation's **New Ingerbelle**, which could add years to mining operations at Copper Mountain (see section 3.1.2.).

7.2.1. Amarillo (Troubadour Resources Inc.)

Troubadour completed a 3D IP survey on its **Amarillo** porphyry Cu project, followed by drilling in December. Initial drilling is to focus on an IP chargeability anomaly in the area of an historical trench from which previous samplers reported 0.87% Cu across 125 m.

7.2.2. Axe (Evrim Resources Corp. 30%; Antofagasta Plc. 70%)

Evrim Resources Corp. and partner Antofagasta started a 3000 m drill program in May, including diamond drilling and reverse circulation drilling. A resource estimate was last updated in 2006 (Table 4), The last drilling was in 2006-2007 by WestStar Resources Corp. Xstrata Canada Corporation conducted airborne geophysics, induced polarization and soil geochemical surveys in 2012. Axe is an alkalic porphyry Cu prospect.

7.2.3. Big Kidd (Jiulian Resources Inc.)

Jiulian Resources reported a high resolution (25 m line spacing) ground magnetic survey over an alkalic porphyry prospect. The results are to guide drilling which was permitted late in the year.

7.2.4. Getty (Getty Copper Inc.)

Getty Copper reported geophysical work in 2018 for assessment. The two advanced prospects on the property, Getty

North and **Getty South**, are about 3 km apart. Getty North has an Indicated 69.258 Mt 0.37% Cu and 0.005% Mo and an Inferred 18.166 Mt 0.271% Cu and 0.005% Mo. Getty South has an Indicated 45.148 Mt 0.377% Cu and Inferred 23.593 Mt 0.278% Cu.

7.2.5. Ike (Hudbay Minerals Inc. 60%; Amarc Resources Ltd. 40%)

Hudbay Minerals funded a program of five widely spaced holes with Amarc as operator. Results included 138 m grading 0.28% Cu, 0.024% Mo, 2.1 g/t Ag; 222 m grading 0.35% Cu, 0.022% Mo, 2.4 g/t Ag and 147 m grading 0.26% Cu, 0.042% Mo, 1.9 g/t Ag. The mineralization remains open.

7.2.6. Lorn (Cyntar Ventures Inc.; Blady 25%; Carlson 25%; Chapman 25%; Paul 25%)

Cyntar Ventures optioned the **Lorn** property and carried out geological mapping and soil and rock geochemistry. They report two new mineralized zones, including a 4 x 2 km Ag-Au-Cu-Mo soil anomaly flanking a magnetic low. The property has porphyry Cu and possible epithermal targets.

7.2.7. Miner Mountain (Sego Resources Inc.)

Sego Resources had two phases of drilling with mapping following the first phase. Among the highlights of the earlier phase were 57 m grading 0.26% Cu and 18 m grading 0.56% Cu. **Miner Mountain** is an alkalic porphyry Cu prospect (Fig. 4), with numerous targets in an area of limited exposure about 18 km northeast of the Copper Mountain mine.



Fig. 4. Chalcopyrite (yellow) and magnetite (black) in Miner Mountain drill core. Crosscut by gypsum (light orange) veinlets.

7.2.8. Moffat (Pacific Empire Minerals Corp.)

Pacific Empire had a small RC drill program on magnetic anomalies identified in a 2018 survey. They report no economic intersections but alteration, pyrite, and elevated copper may warrant follow-up on this grass roots property.

7.2.9. Rabbit North (Tower Resources Ltd.)

Tower drilled 760 m in two holes at **Rabbit North** in 2018. A highlight was 53 m grading 0.32% Cu and 0.22 g/t Au within a larger interval of 288 m grading 0.18% Cu and 0.12 g/t Au. They plan a 3D IP survey next. There are several alkalic porphyry Cu targets on the property.

7.2.10. Rateria (Happy Creek Minerals Ltd.)

Following drilling in 2017, Happy Creek conducted geological mapping and rock sampling at the **Rateria** porphyry Cu-Mo-Au-Ag prospect. They report previously unrecorded bornite mineralization at surface.

7.2.11. Red Property JV (Engold Mines Ltd. 50%; Pacific Empire Minerals Corp. 50%)

Pacific Empire drilled 403 m in eight shallow RC holes at the **Red Property** to test geophysical targets. Although they reported no significant Cu mineralization, targets remain on the property.

7.2.12. Spius (Pacific Ridge Exploration Ltd.)

Pacific Ridge reported a Cu in soil anomaly and an enveloping IP chargeability anomaly, which they interpret as a possible pyritic zone consistent with a porphyry copper deposit model. They have obtained a permit for drilling. The property was explored for porphyry mineralization in the 1960s and early 1970s but little work has been recorded since.

7.3. Selected polymetallic base and precious metal projects

Although 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. Only a few were active in 2018.

7.3.1. Frank Creek (Barker Minerals Ltd.)

Barker Minerals reported geochemistry (rock and soil) and geological work on several of their properties including **Frank Creek** and **Ace**.

7.3.2. Hedge Hog (Surge Exploration Inc.)

Surge Exploration optioned Eastfield Resources Ltd.'s **Hedge Hog** Cu-Au-Ag-Co prospect and carried out geological and geochemical work in September. Massive sulphide mineralized boulders and cobbles were discovered in the area in the 1990s.

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

Two major skarn projects were active in 2018, New Craigmont and Lac La Hache, and the Fox project released an updated resource estimate (Table 4).

7.4.1. Fox (Happy Creek Minerals Ltd.)

At the **Fox** tungsten skarn property, Happy Creek Minerals Ltd. reported results of surface sampling at a previously untested area at the southern part of the Ridley Creek resource area and points south, toward the BN zone. One sample graded 7.43% WO₃ across 0.35 m. Mineralization is in flat-lying sedimentary rocks of the Snowshoe Group (Neoproterozoic to Lower Paleozoic) cut by the Deception stock, a mid-Cretaceous (106 Ma) pluton that ranges in composition from quartz monzonite to muscovite-biotite granite. Since 2005, work has identified seven, near-surface mineralized zones in a system extending across a 3 x 10 km area. In February, Happy

Creek reported an update to the resource estimate with an Indicated 582,400 t 0.826 WO_3 and Inferred 565,400 t 1.231% WO₃ (Table 4).

7.4.2. Lac La Hache (Engold Mines Ltd.)

The Lac La Hache project comprises several target areas including skarn, porphyry, vein and breccia mineralization. Work included diamond drilling and IP surveys at Cu-Au-Ag-Fe skarn targets (Spout North, Spout, G-1, Gap and surrounding targets) and also a gold vein target in the southeastern part of the property (Aurizon). Highlight intersections include 8.8 m grading 3.26% Cu, 0.88 g/t Au, 16.88 g/t Ag, 26.7% Fe at Spout North; 31 m grading 1.14% Cu, 0.28 g/t Au, 6.89 g/t Ag, 24.31% Fe at G1 and 58.5 m grading 0.47% Cu, 0.06 g/t Au, 2.18 g/t Ag, 6.07% Fe at Gap. They obtained up to 25.6 g/t Au in grab samples near the Aurizon and Au in soil anomalies. Drilling continued into late 2018.

7.4.3. New Craigmont (Nicola Mining Inc.)

New Craigmont includes the past producing Craigmont mine and surrounding area. Nicola is exploring for additional copper-iron skarn near the mine and evaluating historical waste dumps as potential ore with reverse circulation drilling. Exploration included diamond drilling, and IP surveys at several zones. An intersection in a hole north of the Craigmont pit returned 73.6 m grading 1.05% Cu. Early in the year, they reported 100.6 m grading1.33% Cu at the Craigmont West zone. Target mineralization is copper-gold skarn in calcareous Nicola Group rocks cut by a southern border phase of the Giuchon Creek batholith.

7.5. Selected specialty metals and industrial mineral projects

Location near transportation corridors and population centres mean low unit value products such as many industrial minerals are potentially viable targets in the region. The South Central Region also has some relatively unusual prospects such as cobalt-bearing polymetallic veins and carbonatites with tantalum, niobium and rare earth element potential.

7.5.1. BC Sugar (Lithium Corporation)

Lithium Corporation excavated 12 test pits at **BC Sugar**, a grass roots stage graphite property. Three encountered weak to moderate graphite mineralization with up to 2.62% graphitic carbon.

7.5.2. Little Gem (Blackstone Minerals Limited)

Blackstone acquired the Little Gem cobalt-gold prospect in 2017. The property includes the Jewel prospect approximately 1 km to the north. Jewel was a minor producer of gold, silver and copper in 1938-1940. Work in 2018 included drilling, an IP survey, rock, soil and stream sediment geochemistry and prospecting. Since acquiring the project, Blackstone reported additional targets, including Roxey, a gold-copper showing, and Erebor, which returned significant cobalt, gold, nickel and

copper assays from rock samples. Some initial drill results include 4.3 m grading 1.0% Co and 15 g/t Au and 3.2 m grading 0.8% Co and 4 g/t Au. The Little Gem hosts vein-type cobalt-gold mineralization with anomalous Ag, Ni, Bi, U and As, in the Coast Plutonic complex near its contact with serpentinite of the Bridge River complex.

7.5.3. Mont (Leo Lindinger)

Mont is a recent discovery of bentonite clay near Stump Lake south of Kamloops. Mr. Lindinger reported starting a series of test pits in November. Aerial imagery and surface observation suggest the area underlain by montmorillonite-rich clay may be significant (Fig. 5).



Fig. 5. An exposure of clay at the Mont bentonite property. Preliminary samples contained a high percentage of montmorillonite.

8. Geological research

Nixon (2018) continued to investigate platinum group element concentrations in sulphides in the Tulameen complex, an Alaskan-type ultramafic intrusive complex west of Princeton, and (Schiarizza, 2019) continued to develop a comprehensive stratigraphic framework for Nicola Group rocks. Plouffe and Ferbey (2018) published a new surficial geology map of the Highland Valley Copper mine area, and Ferbey et al., (2018) examined the geochemistry and mineralogy of subsurface till samples recovered from a diamond drill hole on the Rateria porphyry Cu±Mo property. Rukhlov et al. (2018) published a field trip guidebook to the Upper Fir carbonatite-hosted tantalum-niobium deposit, and Angen (2018) published results of mapping and mineral potential in part of the region. Previously unpublished geochemical data were released by (Lett, 2018a) from near Lillooet and (Lett, 2018b) from the McLeod Lake area.

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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. In the summer of 2017, Nyrstar returned Myra Falls to production, having been on care and maintenance since 2015. Similarly, Quinsam, on care and maintenance since 2016, returned to production in 2017, after being purchased by ERP Compliant Fuels LLC. As of September 2018, Myra Falls was producing concentrate and shipment was expected late in the year. The Quinsam mine is expected to produce about 200,000 t in 2018. Mine site exploration began at Myra Falls late in 2017 and continued in 2018. A permitted exploration program by Quinsam, also began late in 2017 and continued in 2018.

Significant off-lease exploration drilling programs in 2018 include **Surespan Gold, Pemberton Hills** and **Ladner Gold**. About 25 active exploration projects were tracked; most were small scale. BURNCO Rock Products Ltd.'s large aggregate project on Howe Sound, **BURNCO Aggregate**, obtained provincial environmental certification in 2018; Fisheries and Oceans Canada considered that the project was unlikely to harm the environment.

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 Ernst & Young LLP. For the Southwest Region, exploration expenditures were estimated at \$7.8 million and exploration drilling was estimated at approximately 39,800 m (Clarke et al., 2019; Ernst & Young LLP (EY), 2019, in press).

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, 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



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Georgia, and on the western mainland, Wrangellia is buried by rocks of the Nanaimo Group, an Upper Cretaceous continental to marine molassoid succession containing debris derived from 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 now near Campbell River.

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 Late Cretaceous Giant Mascot ultramafic-mafic intrusive suite (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 is 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). For further details about the geology of the Southwest Region see Northcote (2017).

3. Mines

The Southwest Region has one metal mine, one coal mine 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 2018. 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.)

Myra Falls Operations is an underground polymetallic mine that exploits a cluster of volcanogenic massive sulphide lenses. Nyrstar suspended mining activities at the beginning of the second quarter in 2015. In 2017, a \$100 million infrastructure upgrade began, which carried through 2018. The restart project includes: upgrading the H-W shaft and headframe; upgrading the paste plant; diamond drilling to increase resources and reserves; purchasing a new underground fleet; refitting and repairing the concentrator; constructing a new camp; and moving the power house. Infrastructure for hydroelectric power was upgraded. Production of concentrate had resumed by September 2018 and shipments were planned by the end of the year.

Mine	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2018 Production (based on Q1-Q3)	Reserves	Resource	Comments
Myra Falls	Nyrstar Myra Falls Ltd. (parent company Nyrstar N.V.)	Zn, Cu, Pb, Au, Ag; Noranda/ Kuroko massive sulphide; 092F 072, 330, 71, 73	na	P+Pr: 4.89 Mt 6.84% Zn, 0.75% Pb, 0.91% Cu, 71.31 g/t Ag, 1.69 g/t Au	M+I: 7.29 Mt 6.59% Zn, 0.72% Pb, 1.01% Cu, 69.71 g/t Ag, 1.76 g/t Au Inf: 0.94 Mt 9.51% Zn, 1.05% Pb, 0.83% Cu, 136.78 g/t Ag, 2.90 g/t Au	Production ramp up in 2018. Resources inclusive of reserves Dec. 31, 2017.

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 2017 Production (based on Q1-Q3)	Reserves	Resource	Comments
Quinsam	Quinsam Coal Corporation (ERP Compliant Fuels LLC)	Thermal coal; bituminous coal; 092F 319	Approx. 200,000 t clean coal	na	na	Resources and reserves are unpublished. Resumed operations Sept. 2017. Exploration 2017-2018.

Current reserves and resources (Table 1) may be adequate for approximately 10 years at recent mining rates. However, pointing to exploration potential, the company anticipates a longer operating life. Untested target areas remain in this camp, which so far consists of at least 7 significant deposits consisting of at least 50 different sulphide lenses.

The deposits are hosted by the Sicker Group, a Middle Devonian volcano-sedimentary island-arc assemblage that forms basement to Wrangellia beneath much of Vancouver Island (Fig. 1). Ore bodies are in two horizons of the Myra Formation and are generally considered to have formed as Kuroko-type bimodal felsic volcanogenic massive sulphides.

3.2. Coal mines

3.2.1. Quinsam (ERP Compliant Fuels LLC)

Underground coal mining on Vancouver Island dates back to 1849. The **Quinsam** thermal coal mine near Campbell River (Fig. 1) began operation in 1986 but went on care and maintenance in 2016. In 2017, Hillsborough Resources Limited sold the mine. ERP Compliant Fuels, LLC, is affiliated with Conuma Coal Resources Ltd., the company that resumed operations at Wolverine, Brule and Willow Creek in northeastern British Columbia (e.g., DeGrace, 2019). Mining resumed at Quinsam in early fall of 2017. By the end of 2018 more than 80 workers were on site. Production for 2018 was approximately 200,000 t of clean coal. Currently the only underground coal mine in the province, the **Quinsam** mine produces from coal seams in the upper part of the Comox Formation, the basal unit of the Nanaimo Group (Upper Cretaceous). The mine is capable of producing more than half a million tonnes a year. ERP Compliant Fuels is a private company that does not release reserve and resource figures. Product is blended to meet customer specifications. Most recently, the mine supplied local cement plants. The mine can also serve international markets using a freighter loading facility on Texada Island.

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.

Mine	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2018 Production (based on Q1-Q3)	Reserves	Resource	Comments
Apple Bay (PEM 100)	Linceo Media Group Inc.	Silica+alumina; volcanic glass-perlite; 092L 150	na	na	na	Care and maintenance 2018.
Benson Lake	Benson Lake Carbonates ULC	High brightness carbonate; limestone; 092L 295	na	na	na	Care and maintenance 2018.
Blubber Bay	Ash Grove Cement Company	Limestone, dolostone; limestone; 092F 479	Up to 50,000 t dolostone annually	na	100+ years	Care and maintenance, most of 2018. Continues to ship dolomite on contract.
Garibaldi Pumice	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.
Imperial Limestone	Imperial Limestone Co. Ltd.	Limestone; limestone; 092F 394	Approx. 250,000 t annually	na	50+ years	Production number is their high quality product. Resource estimated at roughly 200 Mt.
К2	K2 Stone Quarries Inc.	Dimension stone, flagstone; 092C 159	15,000-20,000 t annually	na	na	Number represents material extracted.
Mount Meager Pumice	Great Pacific Pumice Inc.	Pumice; volcanic ash; 092JW 039	na	na	na	Exploration in 2018.
Sumas Shale	Sumas Shale Ltd. (Lafarge Canada Inc., Clayburn Industrial Group)	Shale, clay, sandstone; residual kaolin; 092GSE024	About 500,000 t annually	na	50+ years	Approximately 55% shale, 45% sandstone for cement production.
Tahsis	Pacific West Stone Inc.	Marble; limestone; 092E 020	na	na	na	Previous owner obtained a quarry permit for Tahsis, but new owner indicates marble production from Leo D'Or site (bulk sample).
Texada Quarry	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.

Table 3. Selected industrial mineral mines and quarries, Southwest 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 Mt range in recent years. It is permitted for up to 7.5 Mt per year. A loading facility capable of accommodating Panamax-class freighters handles most of the shipments. In addition to the Texada Quarry, Lafarge North America operates two of the largest aggregate quarries in the region (Earle Creek and Pitt **River**) each of which typically produces more than 1 Mt per year. Production and employment estimates for 2016 reported by Lafarge for their four largest aggregate operation serving the Lower Mainland include: 1.0 Mt and 23 people at Earle Creek, 1.1 Mt and 21 people at Pitt River Quarry; 1.0 Mt and 17 people at **Central Aggregate**; and 0.9 Mt and 10 people at Ward Road. Remediation work continues at Lafarge's Pipeline Road site.

Near the **Pipeline Road** site are large operations by Jack Cewe Ltd and Allard Contractors Ltd. Together they produce more than 1 Mt most years. Cewe also operates a large quarry on Jervis Inlet at Treat Creek. They do not release yearly production figures.

Polaris Minerals Corporation operates the **Orca** quarry near Port McNeill, which produces sand and gravel mainly for export. Polaris Minerals produced about 3 Mt in 2017. They no longer make production estimates public. In November 2017, shareholders of Polaris Materials Corporation approved an offer from U.S. Concrete Inc. to purchase Polaris. Meanwhile, 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. Van Isle Slate offers a line of hand-cut slate products quarried from rocks of the Leech River complex. The quarry operates intermittently, last producing in 2016. Island Stone Landscape Supply is another established producer and supplier of flagstone, as is San Juan Quarries. Matrix Marble and Stone Inc. continues to quarry marble on Vancouver Island and fabricate a line of products including countertops, sinks, and tiles. They quarry marbles referred to as 'Tlupana Blue Grey' and 'Vancouver Island White' near Hisnit Inlet.

Landscaping stone and dimension stone is quarried in the Squamish-Whistler corridor. The largest operator is Northwest Landscape and Stone Supply, 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 back 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. Ash Grove Cement Company and previous quarry operator Electra Stone Ltd. conducted mine site exploration programs to better define its resources

and to identify higher-silica (>97% SiO_2) material in 2015-2016. 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. In 2017 and 2018, the quarry was on care and maintenance.

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. In future, they plan to mine an average 475,000 tpy of approximately 55% shale and 45% sandstone. Because Clayburn's brick and refractory products plant in Abbotsford closed, fireclay 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 **DeCosmos Lagoon** south of Bella Bella (Fig. 1). They have a new site at the head of **Bute Inlet**, which is likely to supply future raw material. Mining is intermittent: they collected approximately 595 t in 2017. 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 the **Garibaldi Pumice** quarry. Exploration on the property consisted of 12 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. They also reported exploration in 2018.

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.

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 2018.

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 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.

Project	Operator (partner)	Commodity; deposit type; MINFILE	Reserves	Resource	Comments
Black Bear	Polaris Materials Corporation (Parent company US Concrete, Inc.)	Aggregate; crushed rock; 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; sand and gravel; na	na	Approx. 20 Mt	Has environmental certification.
Sechelt Carbonate	Ballinteer Management Inc.	Limestone, dolostone, aggregate; limestone, dolomite, crushed rock; 093GNW031	na	Carbonate rock: 76.1 Mt Gabbro: >700 Mt	Proponent requests project remain in environmental assessment pre-application stage.

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

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; no activity was reported for 2017 or 2018. 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, earlystage, 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 2018 (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 2018, in addition to several smaller projects.

7.1.1. Ashlu (Ashlu Mines Inc.)

Ashlu Mines Inc. is a private company that has assembled

a land position near the former Ashlu mine near Squamish (**Ashlu property**). In 2017 and 2018, they reported continuing geological work and geochemical sampling. A geological, geophysical (VLF-EM), and geochemical (rock, soil, and silt sampling) program that began in 2009 and continued annually since 2011, has relocated showings near the former mine. The Ashlu mine, not part of this project, is a past producer that exploited a narrow (<1 to 4.6 m) gold-bearing quartz vein along a strike length of 90 m and extending 85 m down dip. In 1981, reserves were about 90,000 t of 8.57 g/t Au and 12.31 g/t Ag. The principal target of the surrounding project is mineralization similar to the Ashlu mine. The property is largely underlain by the Cloudburst pluton (Jurassic).

7.1.2. Dancer Group (AMA Gold Exploration Ltd.)

AMA Gold began its proposed program of trenching in 2018, with plans to continue in 2019. AMA is a private company that does not report results. Targets are precious metal bearing veins (Table 5).

7.1.3. GoldCrest, Goldstandard, Goldstar (DSM Syndicate Holdings Ltd.)

Juggernaut Exploration Ltd., a 20% partner in the DSM Syndicate, reported chip sample assays up to 56.1 g/t Au and 124 g/t Ag over 1 m at the **GoldCrest** property northeast of Bella Coola. They also hold the **Goldstandard** property (71.8 g/t Au and 64.4 g/t Ag over 0.5 m) to the west and **Goldstar** property (20.6 g/t Au and 329 g/t Ag over 1 m) to the south. All three are grass roots stage properties in Coast Plutonic complex intrusive, metasedimentary and metavolcanic rocks. Mineralization is mostly described as quartz vein hosted.

Table 5.	Selected	exploration	projects,	Southwest Region.

Project	Operator (partner)	Commodity; deposit type; MINFILE	Resource (NI 43-101 compliant unless indicated otherwise)	Comments
Ashlu	Ashlu Mines Inc.	Au, Ag, Cu; polymetallic veins; 092GNW013	na	Multi-year geology, geochemistry and geophysics continued. Property surrounds the Ashlu past-producing mine.
Dancer Group	AMA Gold Exploration Ltd.	Au, Ag; Au- quartz veins, polymetallic veins; 092GNW008, 12, 63	na	Trenching.
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, 0.310 oz/t Ag AM Breccia zone Historical (open pit): 29,523,030 tons 0.653% Cu, 0.011 oz/t Au, 0.360 oz/t Ag, 0.007% Mo	Permitting, rock geochemistry.
Goldcrest	DSM Syndicate Holdings Ltd.	Au, Ag; Au quartz veins	na	Prospecting, rock geochemistry.
Goldstar	DSM Syndicate Holdings Ltd.	Au, Ag, Zn, Cu	na	Prospecting, sampling. Discovery of gold mineralization.
Jasper	Nitinat Minerals Corporation	Cu, Zn, Au, Ag; Noranda/Kuroko massive sulphide; 092C 080, 37, 81, 88	na	Geophysical interpretation.
Ladner Gold	New Carolin Gold Corp.	Au, Ag; Au- quartz veins; 092HNW003, 7, 18, 092HSW034	Carolin Inf: 12,352,124 t 1.53 g/t Au McMaster Inf: 3,575,000 t 0.69 g/t Au Tailings I: 445,378 t 1.83 g/t Au Inf: 93,304 t 1.85 g/t Au	Drilling; planned 3400 m underground.
Le Mare Lake	Le Mare Gold Corp.	Cu, Mo, Au; porphyry Cu±Mo±Au; 092L 381, 328, 385, 378	na	Drilling 300.5 m in 2 holes.
Lode Gold	Pacific Bay Minerals Ltd.	Au, Ag, Cu, Zn; polymetallic veins Ag-Pb-Zn±Au; 092HSW070	na	Drilling (2 holes).

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Pacific Copper	Vancouver Island Iron Ore Corporation	Cu, Mo, Au, Ag; Cu±Ag quartz veins; 092F 207, 459, 216, 092C 252, 62	na	Geophysics.
Pemberton Hills	Northisle Copper and Gold Inc. (Freeport- McMoRan Mineral Properties Canada Inc.)	Cu, Mo; porphyry Cu ±Mo±Au; 092L 131, 308	na	Drilling 3400 m in 6 holes. IP, geochemistry.
Prosper	New Sunro Copper Ltd.	Au, Ag, Cu; Cu±Ag quartz veins; 092F 053	Historical: 8150 t 32 g/t Au	Proposed work late 2018.
Skyhigh	DSM Syndicate Holdings Ltd.	Au, Ag Cu, Mo; epithermal Au- Ag-Cu, high sulphidation	na	Rock geochemistry.
Surespan Gold	640895 B.C. Ltd.	Au, Ag; Au-quartz veins; 092L 008, 311, 155	Privateer historical: 122,475 t 17 g/t Au	Drilling 6700 m in 34 holes.
Wahleach Creek	Inua Studio	Jade; jade (nephrite); 092HSW099	na	Trenching.
White Fang	Homegold Resources Ltd.	Cu, Ag, Au; Cu skarns; 092L 255	na	Early stage.

M = Measured; I = Indicated; Inf = Inferred

7.1.4. Skyhigh (DSM Syndicate Holdings Ltd.)

Juggernaut Exploration Ltd., a partner in the DSM Syndicate, reported on grass roots prospecting and sampling at the **Skyhigh** property. A highlight was a chip sample returning 15.75 g/t Au and 1845 g/t Ag over 1 m. The property covers a cluster of known epithermal and porphyry occurrences hosted by metamorphic and intrusive rocks of the Coast Plutonic complex, about 32 km north of gold past producers on Loughborough Inlet and Phillips Arm.

7.1.5. Surespan Gold (640895 B.C. Ltd.)

A numbered company doing business as Surespan Gold, drilled approximately 6700 m in the Privateer area near Zeballos (Fig. 2). The project is privately funded and results of 2017 and 2018 work have not been made public. The area is underlain mainly by Jurassic basaltic to rhyolitic volcanic rocks of the Bonanza Group and Eocene intrusive rocks. The Zeballos area hosted 19 gold producers from the 1930s to the late 1990s, mainly from quartz veins. The Privateer mine was the most productive of these, with 170,463 oz of gold recovered. Between 1934 and 1975, the Zeballos camp produced approximately 300,000 oz gold from veins, mostly at the Privateer and Spud Valley mines. Before Surespan's work in 2017, the last significant exploration was in the early 2000s.



Fig. 2. View looking southwest down the Zeballos River valley. Historical mining, including the Privateer mine was mainly on the southeast side of the river. This rugged, heavily vegetated area has seen limited modern exploration.

7.1.6. Ladner Gold (New Carolin Gold Corp.)

New Carolin Gold Corp. completed its acquisition of the **Ladner Gold** project in 2016 and now holds 100% of the property, including the former Carolin mine site (subject to percentage of net smelter returns royalty). Following a surface program in 2016, 2017 work included preparing for underground drilling with a survey of workings, upgrades, and re-timbering. Work in 2018 included the underground drilling. The planned program for 2018 was 3400 m in 28 holes of

which results for 1489 m in 13 holes were reported. This first phase drilling on the Main zone included a highlight of 93 m averaging 1.39 g/t Au including 7 m of 5.75 g/t Au.

Before the recent surface and underground drilling, the company had resource estimates at the past-producing Carolin mine for an open-pit operation of Inferred at 0.5 g/t cut-off of 12,352,124 t grading 1.53 g/t Au and for an underground operation of Inferred at 2.0 g/t cut-off of 2,588,376 t grading 3.34 g/t Au.

The McMaster zone has an Inferred resource of 3,575,000 t grading 0.69 g/t Au at a 0.5 g/t Au cut off. The Carolin mine tailings estimate has 445,378 t at 1.83 g/t Au in the Indicated category and 93,304 t grading 1.85 g/t in the Inferred category.

New Carolin has surrounding tenures covering much of the Coquihalla gold belt, a north-northwest trending series of gold occurrences between Sowaqua and Siwash creeks, which has generally not been well explored by modern methods. Veins of economic interest are found in sedimentary and mafic volcanic rocks northeast of the East Hozameen fault and Coquihalla serpentine belt.

7.1.7. Lode Gold (Pacific Bay Minerals Ltd.)

Pacific Bay drilled two holes targeting a known gold-bearing quartz vein. The property was previously known as **Weaver Lake** or **LD**. It was drilled and trenched in the 1970s and 1990s returning some high grade Au-Ag assays. Aaron Mines Ltd. drove a short adit in 1979-80.

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. Giant Copper (Imperial Metals Corporation)

Imperial reported results of 2017 trenching that followed sampling in 2016, which delineated a 250 x 400 m gold in soil anomaly. Two perpendicular trenches had weighted average gold values of 12.8 g/t Au over 10 m and 9.8 g/t Au over 8 m in continuous channel samples. The company has a Notice of Work for drilling in process.

Elsewhere on the property, a 2006 resource estimate for the Invermay zone describes 17,532,570 tons 0.226% Cu, 0.011 oz/t Au and 0.310 oz/t Ag Indicated. Giant Copper also has historical resources for the AM breccia zone. The open-pit estimate is 29,523,030 tons 0.653% Cu, 0.11 oz/t Au, 0.360 oz/t Ag, 0.007% Mo. The historical underground estimates are 2,565,200 tons 1.223% Cu, 0.017 oz/t Au, 0.626 oz/t Ag, 0.005% Mo and 1,234,500 t 1.155% Cu, 0.013 oz/t Au, 0.682 oz/t Ag, 0.024% Mo historical inferred (non-compliant).

7.2.2. Le Mare Lake (Le Mare Gold Corp.)

Le Mare Gold released a technical report recommending mapping, sampling, and a small initial drill program. This was completed, with 300.5 m in 2 holes at a coincident EM and gold-in-soil anomaly. Since the the late 1960s the area was explored intermittently for porphyry mineralization similar to a cluster of deposits near the past producing Island Copper mine (see Pemberton Hills, below). This remains the primary target.

7.2.3. Pacific Copper (Vancouver Island Iron Ore Corporation)

Vancouver Island Iron Ore, a subsidiary of Canadian Dehua International Mines Group Inc. reported airborne geophysics at **Pacific Copper**. Previously reported mineralization in the area includes copper-bearing veins and copper skarn mineralization. The WWW Au-Ag-Cu-Pb-Zn-vein past producer lies to the west and the Columbia Shear property lies to the east. The area is mainly underlain by basaltic volcanic rocks and lesser carbonate rocks of the Vancouver Group, that are cut by Island Plutonic suite diorite, quartz diorite and feldspar porphyry. Bonanza Group rocks are also mapped in fault contact with the Island Plutonic suite.

7.2.4. Pemberton Hills (Northisle Copper and Gold Inc. 35%; Freeport-McMoRan Mineral Properties Canada Inc. 65%)

In the Island Copper belt on northern Vancouver Island, 2018 work focussed on the early-stage Pemberton Hills area, under option to Freeport McMoRan. In addition to an IP survey, they drilled 3400 m in 6 holes. The target is a 1.5 x 3.5 km area of advanced argillic alteration (Figs. 3, 4). Historically, drilling has encountered anomalous copper about 200 m deep, suggesting there may be blind porphyry copper mineralization at depth. Several porphyry copper and epithermal gold targets extend along a 40 km west-northwest trend from Island Copper. Among these are the more-advanced Hushamu and Red Dog deposits to the west. Hushamu has an Indicated 304,000,000 t of 0.21% Cu, 0.29 g/t Au, 0.010% Mo, and 0.56 ppm Re and Inferred 205,600,000 t 0.18% Cu, 0.26 g/t Au, 0.008% Mo and 0.38 ppm Re. Red Dog has 23,633,000 t at 0.32% Cu, 0.46 g/t Au and 0.007% Mo Indicated and 848,000 t at 0.23% Cu, 0.33 g/t Au and 0.003% Mo Inferred. The Red Dog and Hushamu resources together were subject of a 2017 preliminary economic assessment. The Island Copper mine produced 345 Mt with average head grades of 0.41% Cu, 0.017% Mo, and 0.19 g/t Au between 1971 and 1994. Alteration similar to that observed at higher levels of these nearby deposits is well known in the Pemberton Hills area, but similar mineralization has not yet been discovered.

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 2018.

7.3.1. Jasper (Nitinat Minerals Corporation)

Nitinat reports geological mapping and lithogeochemistry in 2018. This follows re-interpretation of existing geophysical data in 2017.



Fig. 3. The Pemberton Hills area. The hill in the centre of the field is being mined for silica-rich and clay-rich altered volcanic rock. Hills are resistant silicic caps over an area of intense hydrothermal alteration. The possibility of mineralization at depth has prompted speculation, but limited exploration until 2018.



Fig. 4. Advanced argillic alteration is common in the Pemberton Hills area where rocks are exposed. Historical drilling encountered anomalous copper at depth.

7.3.2. Lara (Treasury Metals Inc.)

Treasury Metals carried out a lidar and orthophoto survey at the **Lara** in 2018. The high forest fire hazard during the summer delayed further work.

7.4. Industrial minerals, jade, and aggregates

Exploration for industrial minerals and aggregates is commonly carried out by individuals and private companies and typically goes unreported. Of the more than 600 quarry and sand and gravel operations with active permits not all are currently producing or conducting investigative work.

7.4.1. Wahleach Creek (Inua Studio)

Inua Studio is exploring and trenching a jade occurrence in ultramafic rocks mapped as Yellow Aster complex near the Washington Border. They have obtained nephrite samples up to A- grade.

8. Summary

A restart project at Myra Falls that began in 2017 continued in 2018, including a substantial exploration effort. Although the footprint of the operation is geographically constrained by park boundaries, Nyrstar and previous operators have demonstrated the ongoing exploration potential of the Myra Falls camp. Production of concentrate ramped up through the second half of the year. Quinsam coal mine continued to produce after a shut down in 2016 and re-start in 2017 under new ownership. Resource areas could augment reserves for many years.

Away from mine sites, the level of exploration in the southwest remains low, as has been typical of recent years. Exceptions were in areas of high mineral potential that appear under-explored by modern methods and where communities generally welcome industry: Pemberton Hills, the Zeballos camp and Coquihalla gold belt. Grass roots work on the central coast and a recent discovery at Giant Copper point to potential for discovery in both unexplored and established camps.

Industrial minerals and aggregates remain the backbone of the mining industry in the southwest. Recent years have seen a trend toward consolidation in the hands of major international construction materials companies with large operations.

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Exploration and mining in the Northwest Region, British Columbia

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1. Introduction

The Northwest Region includes about 263,000 km² of British Columbia, approximately 25% of the province (Fig. 1). The region has three operating mines and five proposed mine projects. More than 60 exploration projects were active in 2018, predominantly focussed on precious metal and porphyry style copper-gold mineralization.

In 2018, 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 Ernst & Young LLP. For the Northwest Region, exploration expenditures were estimated at \$164.0 million and exploration drilling was estimated at approximately 293,500 m (Clarke et al., this volume; Ernst & Young LLP (EY), 2019, in press).

The Northwest Region saw several significant events in 2018. Coeur Mining Inc. declared commercial production in September for the **Silvertip** mine they had acquired in October of 2017. In December, Pretium Resources Inc., received approval from the British Columbia Ministry of Energy, Mines and Petroleum Resources and Ministry of Environment and Climate Change Strategy to increase production from 2700 tpd to 3800 tpd.

IDM Mining Ltd. announced an updated mineral resource estimate of 2.77 Mt of 7.91 g/t Au and 22.75 g/t Ag, Measured plus Indicated, for their **Red Mountain** project. The project is a proposed high-grade underground gold mine. As well, they were granted their provincial environmental assessment certificate. A federal certificate is anticipated in early 2019.

Seabridge Gold Inc. extended the high-grade core of the Iron Cap deposit at their **KSM** project. Results included 548 m of 0.63 g/t Au and 0.44% Cu.

The first drill hole of 2018 at the North Boundary zone (NBZ), part of Aben Resources Ltd.'s **Forest Kerr** project, intersected multiple high-grade zones including 38.7 g/t Au over 10.0 m. Subsequent holes also returned high-grade gold assays.

Several companies reported new porphyry discoveries in 2018. GT Gold Corp. reported results for their **Tatogga** projects'

Saddle North target, approximately 1.5 km east-northeast of last year's Saddle South gold discovery, including 363 m of 1.02 g/t Au, 0.51% Cu and 1.72 g/t Ag within 904 m of 0.51 g/t Au, 0.30% Cu and 0.93 g/t Ag. Golden Ridge Resources Ltd. announced discovering a new copper-gold porphyry at their Hank project's Williams zone. Their first hole intersected 327 m grading 0.31% Cu, 0.35 g/t Au and 1.94 g/t Ag. Surge Copper Corp. (formerly Gold Reach Resources Ltd.) discovered a new copper zone 500 m northeast of the East Seel deposit at their Ootsa project. The discovery hole intersected 202 m of continuous mineralization and assayed 0.26% Cu, 0.31 g/t Au and 1.32 g/t Ag. ML Gold Corp. reported that drilling at two new targets on their Stars project intersected mineralized porphyry. In February, they announced 204 m assayed 0.45% Cu, 0.045 g/t Au, 1.64 g/t Ag, 0.0048% Mo. In August, they announced 405 m assayed 0.20% Cu, 0.0082% Mo, 0.754 g/t Ag and 24 ppb Au.

2. Geological overview

Metallogeny in British Columbia is intimately 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 region includes all of the physiographic belts of the Canadian Cordillera (Fig. 1), and transects the Cordilleran orogen (Fig. 1). From east to west it is underlain by: 1) autochthonous and parautochthonous carbonate and siliciclastic strata deposited on the flank of Ancestral North America (Laurentia); 2) the Intermontane terranes, including the Slide Mountain terrane (back-arc basin); the Yukon-Tanana terrane (a rifted Devonian pericratonic arc); the Quesnel and Stikine volcanic arc terranes (formed outboard of Ancestral North America starting in the Late Paleozoic and accreted in the Middle Jurassic); and the Cache Creek oceanic terrane, which intervenes between Quesnellia and Stikinia; 3) the Alexander terrane; 4) post-accretionary rocks; and 5) younger cover rocks (Fig. 1).

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Fig. 1. Mines, proposed mines and selected exploration projects, Northwest Region, 2018. Terranes after Nelson et al. (2013).

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All of the allochthonous terranes initially accreted to each other and to western North America in the Jurassic. Since then, the mosaic has been intruded by post accretion plutonic suites and covered, in part, by Jurassic and younger syn- and post-accretionary siliciclastic deposits. For details about the geology, metallogeny, and tectonics of the Northwest Region see Nelson et al. (2013).

3. Mines and quarries

During 2018, three significant metal mines operated in the region (**Red Chris, Brucejack and Silvertip**; Fig. 1; Table 1). Ten industrial mineral mines were tracked, including eight jade operations (Fig. 1; Table 2). Placer mining has been active in the Northwest Region for well over a century. Operations are mainly in the Atlin area and, to a lesser extent, in the Cassiar area. Numerous small aggregate operations supply mainly local needs throughout the region and are not discussed in this report.

3.1. Metal mines

The **Brucejack** and **Red Chris** mines operated throughout the year and the **Silvertip** mine declared commercial production in September.

3.1.1. Brucejack (Pretium Resources Inc.)

The **Brucejack** underground gold-silver mine is about 65 km north-northwest of Stewart. Road access is via combined all-weather dirt road and glacier road. An all-season airstrip is on the road access, approximately 20 km southeast of the mine site. Pretium completed a feasibility study in 2014 and started construction in September 2015. In July 2107, commercial production was announced. For the first three quarters ended September 30th, production totalled 279,670 oz Au and 308,676 oz Ag from 738,555 t of ore grading 12.0 g/t Au. Gold recoveries averaged 97.4%. Free gold and electrum is recovered to produce gold-silver doré, which is flown off site from their airstrip. In December 2018, Pretium received approval from the British Columbia Ministry of Energy, Mines and Petroleum Resources and Ministry of Environment and Climate Change Strategy to increase production from 2700 tpd to 3800 tpd.

Total mineral reserves and resources for the mine are based on the Valley of the Kings (VOK) and West zones. In December 2016, Pretium reported Proven plus Probable reserves for the VOK as 15.6 Mt grading 16.1 g/t Au and 11.7 g/t Ag. Proven plus Probable reserves for the West zone was reported as 2.9 Mt grading 6.9 g/t Au and 279 g/t Ag. Combined reserves are reported as 18.5 Mt grading 14.6 g/t Au and 53.5 g/t Ag. Reported Measured plus Indicated resources for the VOK zone are 16.4 Mt grading 17.2 g/t Au and 15.0 g/t Ag. Additional Inferred resources total 4.6 Mt grading 21.0 g/t Au and 26.9 g/t Ag. For the West zone, Measured plus Indicated were reported at 4.9 Mt grading 5.85 g/t Au and 267 g/t Ag. Additional Inferred resources total 4.0 Mt grading 6.44 g/t Au and 82 g/t Ag. Mineral resources are inclusive of reserves. Regional exploration efforts continue to follow up new targets outside of the mining lease in their surrounding 1200 km² of mineral claims (see section 6.3.1.).

3.1.2. Red Chris (Red Chris Development Company Ltd.)

The **Red Chris** copper-gold mine is accessed by a controlled mine road from highway 37. The project is owned by Red Chris Development Company Ltd., a subsidiary of Imperial Metals Corporation. Production to the end of the 3rd quarter of 2018 totalled 44.78 Mlbs Cu and 29,569 oz Au from 7.93 Mt of ore grading 0.34% Cu and 0.25 g/t Au. Metal recoveries averaged 75.39% for Cu and 45.82% for Au.

The Red Chris copper-gold deposit is hosted in a 204 Ma diorite-monzonite that intrudes Upper Triassic rocks of the Stuhini Group. The 6.5 x 1.5 km porphyry consists of four main intrusive phases. The second phase (P2) contains most of the copper and gold, and measures greater than 2 km x 650 m in plan and extends to a depth of more than 1.5 km. The syn-mineral P2 intrusive phase is high-potassic, calcalkalic in composition and contains abundant 'A' type quartz-chalcopyrite-magnetite+/-bornite veins (Rees et al., 2015).

Measured plus Indicated resources total 1.035 Bt with an average grade of 0.35% Cu, 0.35 g/t Au and 1.14 g/t Ag. Additional Inferred resources total 787.1 Mt grading 0.29% Cu, 0.32 g/t Au and 1.04 g/t Ag. Resource figures are for combined open-pit and planned underground operations and do not take into account any mining since start-up.

3.1.3. Silvertip (Coeur Mining Inc.)

Coeur purchased the **Silvertip** silver-zinc-lead mine in October of 2017 for about \$250 million. Coeur proceeded to upgrade facilities and restart mining. In September 2018, commercial production was declared. Coeur Mining Inc. also carried out a 57,660 m of exploration drilling at the mine site. Designed as infill drilling, the program also discovered new zones. Surface drilling at the Discovery zone intersected new mineralization including 11.4 m of 193.3 g/t Ag, 18.3% Zn and 3.2% Pb, and 6 m of 925.7 g/t Ag, 16.0% Zn and 15.2% Pb. The Discovery zone remains open to the north, south, and east, and at depth. New multiple stacked manto horizons and vertical feeders were intersected at the Silver Creek zone. Results included 3.8 m of 905.5 g/t Ag, 29.2% Zn and 16.5% Pb.

The Silvertip deposit is in the Cassiar terrane. The ore body consists of five zones: the Silver Creek, the 28, the 65, the Discovery and the Discovery North. The zones consist of massive sulphide bodies in limestones of the McDame Group and are unconformably overlain by Devonian-Mississippian rift-related, siliciclastic rocks of the Earn Group. Current Indicated resource estimates are 2.59 Mt at 10.26 oz/ton Ag, 6.74% Pb and 9.41% Zn.

3.2. Industrial mineral mines and quarries

Ten industrial mineral mines were tracked, including eight jade producers and two industrial rock quarries (Table 2).

Mine	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2018 Production (based on Q1- Q3)	Reserves	Resource	Comments
Brucejack	Pretium Resources Inc.	Au, Ag; Au-quartz veins, quartz stockwork breccia, epithermal; 104B 193	372,900 oz Au, 411,600 oz Ag	P+Pr: combined, VOK zone and West zone 18.5 Mt at 14.6 g/t Au, 53.5 g/t Ag	M+I: VOK zone 16.4 Mt at 17.2 g/t Au and 15.0 g/t Ag M+I: West zone 4.9 Mt at 5.85 g/t Au and 267 g/t Ag. Resources are inclusive of Reserves	Announced steady production in 2 nd quarter. Received government approval to increase production rate to 3800 tpd from 2700 tpd.
Huckleberry	Huckleberry Mines Ltd.	Cu, Au, Ag, Mo; porphyry Cu-Mo-Au; 093E 037	na	P+Pr: approx., 34.96 Mt at 0.32% Cu, 0.01% Mo	M+I: 180.7 Mt at 0.32% Cu., 0.01% Mo	Placed on care and maintenance in 2016.
Red Chris	Red Chris Development Company Ltd.	Cu, Au, Ag; porphyry Cu-Au; 104H 005	59.71 Mlbs Cu, 39,425 oz Au and 102,733 oz Ag	P+Pr: 301.5 Mt at 0.36% Cu, 0.27 g/t Au	M+I: 1.035 Bt at 0.35% Cu, 0.35 g/t Au and 1.14 g/t Ag	First year of full production in 2016. Reserve and Resource figures are for combined open- pit and planned underground operations and do not take into account mining since start-up.
Silvertip	Coeur Mining Inc.	Ag, Pb, Zn, Au; polymetallic manto; 104O 038	na	na	I: 2.59 Mtons at 10.26 oz/ton Ag, 6.74% Zn, 9.41% Pb	Commercial production declared in September. Mine site drilling returned results including 11.4 m of 193.3 g/t Ag, 18.3% Zn and 3.2% Pb and located new mineralization.

Table 1. Metal mines, Northwest Region.

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

3.2.1. Nephrite Jade

Jade is the commercial term for jadeite and nephrite. In British Columbia, jade occurs as nephrite. Nephrite is composed of interlocking fibrous amphibole minerals derived from an ultramafic protolith that has undergone dynamothermal metamorphism and metasomatism. The two significant areas of nephrite jade extraction in the Northwest Region are east of Dease Lake in the Turnagain River area, and north of Dease Lake in the Cassiar area. Production varies between operations and ranges from 200 to 2000 t per year.

3.2.2. Industrial rock quarries

The Burning Daylight basalt stone quarry is owned by

Stone Ridge Quarries Limited. Access to the project is via a forest service road. Stone Ridge mines basalt for landscape and building stone markets.

The **Kalum** quarry is 3 km west of Terrace at the confluence of the Kitsumkalum and Skeena Rivers on the traditional territory of the Kitsumkalum First Nation. The quarry is owned and operated by the Kalum Quarry Ltd. Partnership, a subsidiary of the Kitsumkalum First Nation. The quarry has road access and a 3 km rail line connecting it to the CN mainline. Rock is drilled, blasted, and crushed on site to meet specific contact requirements. Various aggregate size products are produced for industrial and residential purposes. Typical products include large diameter rip-rap, railway ballast, asphalt crush, and finer

Mine	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2018 Production (based on Q1-Q3)	Reserves	Resource	Comments
Burning Daylight	Stone Ridge Quarries Ltd.	Columnar basalt; dimension stone	unknown	na	na	Basalt quarrying.
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; 104I 048	unknown	na	na	Trenching, quarrying, placer production.
Kalum	Kalum Quarry Ltd. Partnership	Industrial rock; crushed rock	unknown	na	na	Drilling, blasting, crushing, production for CN railway bed.
Kutcho Creek Jade	Continental Jade Ltd.	Nephrite jade; gems and semi- precious stones; 104I 078	unknown	na	na	Mining, trenching.
Letain	Cassiar Jade Contracting Inc.	Nephrite jade; gems and semi- precious stones; 104I 079	unknown	na	na	Mining, trenching.
Polar Jade	Glenpark Enterprises Ltd.	Nephrite jade; gems and semi- precious stones; 104I 092	unknown	na	na	Mining.
Provencher	Glenpark Enterprises Ltd.	Nephrite jade; gems and semi- precious stones; 104I 092	unknown	na	na	Mining, trenching.
Wolverine	Cassiar Jade Contracting Inc.	Nephrite jade; gems and semi- precious stones	unknown	na	na	Mining, trenching.

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

materials for concrete. An estimated 22 million cubic metres of material remains available for development. Basalt and andesite of the Hazelton Group are quarried.

3.2.3. Placer operations

Placer mining operations have been active in the Northwest Region for well over a century. Because of the large number of mines and difficulty in obtaining information, these operations are not tracked.

4. Mine development

The mine development stage is achieved when a project acquires the required permits and has started mine construction. Essential permits include a Mines Act permit from the Ministry of Energy, Mines and Petroleum Resources, and an Environmental Management Act permit from the Ministry of Environment. Provincial and federal environmental assessment certificates may also be required. There were no mine development projects in the region in 2018.

5. Proposed mines or quarries

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

5.1. Selected proposed metal mines

The Northwest Region has several proposed metal mines, five of which have been active within the past three years and/ or hold permits to allow construction if financing becomes available (Fig. 1; Table 3).

5.1.1. Dome Mountain (Gavin Mines Inc.)

The **Dome Mountain** past-producing gold mine is accessed by forest service roads from highway 16. Gavin Mines Inc., a subsidiary of Metal Mountain Resources Inc. owns 54%, Grace Mining Inc. owns 30%, Dome Mountain Resources of Canada Inc. owns 14%, and two private shareholders own 2%. The project has Mines Act and Environmental Management Act permits in good standing and is allowed to extract up to 75,000 tpy. In early 2013, the project submitted applications to amend their existing Mines Act and Environmental Management Act permits to allow onsite milling and tailings storage. Due to delays, including regulatory changes due to the 2014 Mount Polley tailings breach, the permit amendments remain outstanding. Since 2016, stockpiled ore has intermittently been processed at Nicola Mining Inc.'s custom mill near Merritt.

5.1.2. Galore Creek (Galore Creek Mining Corporation)

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 Mining Corporation. Newmont purchased their 50% interest from Novagold Resources Inc. in July. 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 percent basis). The project consists of thirteen 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.

5.1.3. KSM (Seabridge Gold Inc.)

Owned by Seabridge Gold Inc., the **KSM** project occupies the adjoining mineral claims west of the Brucejack mine. Access to KSM is via helicopter. The project consists of four porphyry Cu-Au deposits: Kerr, Sulphurets, Mitchell, and Iron Cap. In 2018, Seabridge continued to drill the Iron Cap deposit. Results extended its high-grade core down plunge and will be used to produce an upgraded resource estimate. Highlight results included 548 m of 0.63 g/t Au and 0.44% Cu. KSM economics might be improved if the Iron Cap deposit is mined before the Kerr deposit.

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 2.924 Bt grading 0.52 g/t Au, 0.21% Cu, 2.7 g/t Ag and 55 ppm Mo. Seabridge received federal and provincial approval of the project environmental assessment in 2014 and is actively seeking partnership to advance into construction.

The KSM deposits are related to the Mitchell intrusions of the Texas Creek plutonic suite (Early Jurassic; ~194 Ma). Diorite, monzonite and quartz-syenite stocks and dikes intrude along the Sulphurets fault (pre-Early Jurassic) into surrounding sedimentary and volcanic rocks of the Stuhini and Hazelton groups. Mineralization is disseminated and in stockwork veins, and consists of fine-grained chalcopyrite, bornite, molybdenite, and pyrite.

5.1.4. Morrison (Pacific Booker Minerals Inc.)

Access to the **Morrison** Cu-Au-Mo-Ag project is by road and barge. Proven plus Probable reserves are reported as 224.25 Mt at 0.33% Cu, 0.163 g/t Au and 0.004% Mo. Proposed is an open-pit operation with a 30,000 tpd mill, equating to a 21-year mine life.

Pacific Booker submitted an EA application in 2010, which was denied in 2012. In late 2013, a Supreme Court ruled procedural fairness was not adhered to in the 2012 rejection and required the EAO to accept a remitted application for reconsideration. After the Mount Polly tailings breach, the review was suspended, but then resumed in June 2015. In July 2015, a letter from the British Columbia Minister of Environment and Minister of Energy and Mines stated that concerns still remained regarding the project design and that further information was required. In 2018, Pacific Booker continued to lobby for the project.

5.1.5. Red Mountain (IDM Mining Ltd.)

The **Red Mountain** project is a proposed high-grade underground gold mine 18 km east-northeast of Stewart. In 2018, IDM Mining Ltd., carried out a 40 hole, 10,000 m diamond drilling program and announced an updated mineral resource estimate of 2.77 Mt of 7.91 g/t Au and 22.75 g/t Ag, Measured plus Indicated. As well, they were granted their provincial environmental assessment certificate. A federal certificate is anticipated in early 2019.

The project contains five known underground gold zones; Marc, AV, JW, 141 and 132.

Mineralized zones consist of crudely tabular, northwesterly trending and moderately to steeply southwesterly dipping gold and silver-bearing iron sulphide stockworks. Mineralized widths vary from less than 2 m to 40 m and average 16 m. The stockwork zones consist of pyrite microveins, coarse-grained pyrite veins, irregular coarse-grained pyrite masses and breccia matrix pyrite hosted predominately in a pale, strongly sericite-altered porphyry. Vein widths vary from 0.1 to 80 cm but widths of 1 to 3 cm are most common. The veins are very commonly

Project	Operator (partner)	Commodity; deposit type; MINFILE	Reserves	Resource	Comments
Dome Mountain	Dome Mountain Resources of Canada Inc.	Au, Ag; vein breccia and stockwork; 093L 022	na	na	Permit amendments outstanding. Stockpiled ore intermittently processed at Nicola Mining Inc. mill near Merritt.
Galore Creek	Galore Creek Mining Corp. (50% Teck Resources Limited, 50% Newmont Mining Corporation)	Au, Cu; alkalic porphyry; 104G 090	P+Pr: 528 Mt at 0.59% Cu, 0.32 g/t Au, 6.02 g/t Ag	M+I: 286.7 Mt at 0.33% Cu, 0.27 g/t Au, 3.64 g/t Ag. Resources exclusive of Reserves	Baseline monitoring. Newmont purchased 50% interest from Novagold Resources Inc. in July. Multi-year prefeasibility study announced, with an annual budget of \$10 to \$15 million (50% basis).
KSM	Seabridge Gold Inc.	Au, Cu, Ag, Mo; calc-alkalic porphyry; 104B 191	P+Pr: 2.198 Bt at 0.55 g/t Au, 0.21% Cu, 2.6 g/t Ag, 0.00426% Mo	M+I: 2.925 Bt at 0.52 g/t Au, 0.21% Cu, 2.7 g/t Ag, 0.0055% Mo. Resources include mineral Reserves	Results from 2018 drilling at the Iron Cap deposit extended its high-grade core down plunge and will be used for an upgraded resource estimate. Highlight results included 548 m of 0.63 g/t Au and 0.44% Cu.
Morrison	Pacific Booker Minerals Inc.	Cu, Mo; calc-alkalic porphyry; 093M 007	P+Pr: 224.25 Mt at 0.33% Cu, 0.163 g/t Au, 0.004% Mo	na	Baseline monitoring, EA ongoing. Resource information from company website.
Red Mountain	IDM Mining Ltd.	Au, Ag; porphyry related gold; 103P 086	na	M+I: 2.771 Mt at 7.91 g/t Au, 22.75 g/t Ag	Diamond drilling (40 hole, 10,000 m). Announced an updated M+I resource estimate. Granted a provincial environmental assessment certificate; federal certificate anticipated in early 2019.

Table 3. Selected proposed mines, Northwest Region.

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

heavily fractured or brecciated with infillings of fibrous quartz and calcite. The pyrite veins typically carry gold grades ranging from \sim 3 g/t to greater than 100 g/t. Gold occurs as grains of native gold, electrum, petzite, and a variety of Au tellurides and sulphosalts. Pyrite is the predominant sulphide, although pyrrhotite is locally important. The stockwork zones also occur to a lesser extent in rafts of sedimentary and volcaniclastic rocks.

6. Selected exploration activities and highlights

Exploration-stage projects are defined as the initial stages of evaluation for economic minerals. This includes grassroots activities such as prospecting, rock and soil sampling, regional mapping and airborne geophysical surveys. Early-stage activities include more focussed sample grids, geophysical surveys, prospect-scale geological mapping, drill target generation, and testing that set the stage for future mine evaluation. Collecting baseline environmental data is also common at this stage.

Table 4.	Selected	exploration	projects.	Northwest F	Region.
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Project	Operator (partner)	Commodity; deposit type; MINFILE	Resource (NI 43-101 compliant unless indicated otherwise)	Comments
Atlin Gold Project	Brixton Metals Corporation	Au; precious metal veins	na	Geological mapping, rock and chip sampling, biogeochemical studies, and 2500 soil samples. Several gold-in-soil anomalies.
Berg	Centerra Gold Inc.	Cu, Mo, Ag; porphyry; 093E 046	M+I: 557 Mt at 0.3% Cu, 0.037% Mo, 3.12 g/t Ag	Mapping and sampling in the Berbette and A12 target areas. Soil sampling t on the A12 target.
Boomerang	Hawkeye Gold and Diamonds Inc.	Cu, Au; porphyry	na	Soil and rock sampling. Rock samples returned Cu grades ranging from 0.10% to 1.80%.
Brucejack Regional	Pretium Resources Inc.	Au, Ag; epithermal vein	na	Evaluation of 1250 km ² of mineral claims surrounding the mine area. Diamond drilling (8000 m), mapping and prospecting. At the American Creek zone, drilling highlight results included 1.5 m grading 10.15 g/t Au and 25.5 m grading 41.54 g/t Ag, 2.12% Zn and 0.56% Pb. Prospecting sample results located the new Upper Kirkham zone. Samples assayed as high as 3.55 g/t Au, greater than 10,000 g/t Ag, 4.7% Cu, greater than 20% Pb and 3.8% Zn.
Clone	Sunvest Minerals Corp.	Au, Ag, Cu, Co; Au; precious metal veins; 103P 251	na	Geochemical rock, silt and soil sampling, detailed geological mapping and packsack drilling. A number of samples returned anomalous Cu, Ag and Au assays. A newly discovered mineralized vein returned a 1 m chip sample result of 4.11% Cu, 160g/t Ag, 0.52g/t Au.
Dolly Varden	Dolly Varden Silver Corporation	Ag, Zn; Noranda/ Kuroko massive sulphide; 103P 188	I: 3.073 Mt at 321.6 g/t Ag Inf: 898,500 t at 373.3 g/t Ag	Drilling, 29,108 m in 84 holes. A new zone, (Bonus) discovered. Results included 15.50 m grading 161.4 g/t Ag, 0.25% Pb and 0.20% Zn. Drilling on known zones included 24.00 m grading 287.5 g/t Ag, 0.29% Pb, and 0.11% Zn at Torbrit East and 29.15 m grading 226.0 g/t Ag, 0.09% Pb, and 0.13% Zn at the Moose-Lamb zone.
Duke	Amarc Resources Ltd.	Cu, Mo, Au; porphyry Cu-Au; 093M 009, 121, 163	Historic non NI 43-101 compliant I: 41 Mt at 0.25% Cu, 0.01% Mo	Property straddles the Northwest and North Central regions. Six diamond drill holes totalling 3600 m completed. Highlight results included 348 m grading 0.23% Cu, 0.013% Mo, 1.1 g/t Ag, 0.05 g/t Au.
Dunwell	American Creek Resources Ltd.	Au, Ag, Pb, Zn; polymetallic veins; 103P 052	na	30 rock samples from both surface and historic underground workings. Reported results included high-grade Au (up to 61.2 g/t) and Ag (up to 1186 g/t) along with base metals.
Engineer	Engineer Gold Mines Ltd.	Au, Ag; epithermal veins; 104M 014	Inf: 41,000 t at 19.0 g/t Au	MMI soil sampling. Heavy equipment, fuel and diamond drill equipment barged to mine site in preparation for 2019 work.

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Clarke

Table 4. Continued.

Eskay Creek	Skeena Resources Limited	Au, Ag, Zn, Cu, Pb; VMS; 104B 008	I: 1.08 Mt at 4.9 g/t Au, 72 g/t Ag (pit constrained) Inf: 4.26 Mt at 3.3 g/t Au, 72 g/t Ag (pit constrained) I: 2.51 Mt at 7.2 g/t Au, 215 g/t Ag (underground) Inf: 0.81 Mt at 7.2 g/t Au, 214 g/t Ag (underground)	Diamond drilling, compiled and reviewed 20 years of exploration and production information and completed a geologic model and resource estimate. Drilling highlights include 14.55 m grading 7.36 g/t Au, 1189 g/t Ag and 31.50 m grading 10.16 g/t Au, 331 g/t Ag and 42.65 m grading 9.49 g/t Au, 111 g/t Ag.
Forest Kerr	Aben Resources Ltd.	Au, Ag, Cu; precious metal veins	na	Diamond drilling, 36 holes totalling 9900 m. Drilling intersected multiple high- grade zones including 38.7 g/t Au over 10.0 m.
Golddigger	Goliath Resources Limited	Au, Ag, Pb, Cu; polymetallic veins	na	A 0.55 m channel sample graded 29.70 g/t Au and 14.30 g/t Ag, a 0.50 m chip sample graded 47.50 g/t Au and 272.00 g/t Ag and grab samples graded up to 113.50 g/t Au and 249.00 g/t Ag.
Hank	Golden Ridge Resources Ltd.	Au, Cu; calc-alkalic porphyry	na	Drilling discovered new porphyry Cu-Au at the Williams zone. Discovery hole returned 327 m grading 0.31% Cu, 0.35 g/t Au and 1.94 g/t Ag.
Hat	Doubleview Capital Corp.	Au, Cu; calc-alkalic porphyry; 104J 015	na	Project optioned to Hudbay Minerals Inc. Hudbay by Doubleview Capital Corp. In the summer, a 40 line-km, deep-penetrating induced polarization survey was carried out to delineate drilling targets.
Iskut	Seabridge Gold Inc.	Au, Ag, Cu; intrusion related, calc-alkalic porphyry; 104B 107	na	Diamond drilling (2700 m) to test for high-grade epithermal precious metal mineralization, but encountered mineralization typical of a large porphyry Cu-Au system.
Keaper	Casa Minerals Inc.	Ag, Cu, Pb, Zn; polymetallic veins	na	Rock and soil sampling. Highlight rock sample results included 1512 g/t Ag with 0.88% Cu, 1.19% Pb, 13.9% Zn and >100 g/t Ag with 0.33% Cu.
Kinaskan-Castle	Colorado Resources Ltd.	Cu, Mo, Au; porphyry Cu- Au	na	IP surveying produced chargeability anomalies coincident with large gold and copper soil geochemical anomalies extending east-west for more than 2000 m. The anomalies are interpreted to be in the same stratigraphic unit that hosts the Saddle North and Saddle South discoveries on GT Gold's Tatogga property. Permits to allow drilling received in October.
Kinskuch (Hecla)	Hecla Quebec Inc.	Ag, Cu, Pb, Zn; polymetallic veins	na	Diamond drilling defined silver-enriched base metal mineralization over a strike length of 4.8 km.

Table 4. Continued.

Kirkham	Metallis Resources Inc.	Au, Cu; calc-alkalic porphyry and Au, Ag, intrusion related; 104B 079	na	Although a porphyry Cu-Au target, drilling at Cole intersected an intrusion-related massive sulphide pyrite-pyrrhotite vein that assayed 11.18 g/t Au over 7.7 m.
Kirkham (Thunder North)	Metallis Resources Inc.	Ni, Cu; tholeiitic intrusion- hosted Ni-Cu	na	The project is approximately 2 km southeast of Garibaldi Resource's Nickel Mountain project. Diamond drilling to test airborne electromagnetic and magnetic targets underway in the fall.
KSP	Colorado Resources Ltd.	Au, Cu; calc-alkalic porphyry and Au, Ag, intrusion related; 104B 111, 13	na	Diamond drilling, 7847 m in 35 holes. Results included 32 m grading 0.32 g/t Au and 1.64% Zn and 50 m grading 2.28 g/t Au, including 6 m grading 7.36 g/t Au.
Kutcho	Kutcho Copper Corp.	Cu, Pb, Zn, Au, Ag; VMS; 104I 060	M+I: 16.853 Mt of 1.89% Cu, 2.87% Zn, 0.36 g/t Au and 32.8 g/t Ag (at a 1.0% Cu cut- off)	Results from 2018 drilling included 28 m of 2.09% Cu, 6.1% Zn, 65.8 g/t Ag, 0.82 g/t Au and 5.4 m of 2.48% Cu, 1.0% Zn, 114.0 g/t Ag, 0.24 g/t Au. A bench scale metallurgical study is underway and a feasibility study is scheduled for 2019.
Maroon	Gitennes Exploration Inc.	Au, Pb, Zn; pollymetallic veins; 103I 029	na	Reconnaissance prospecting found several polymetallic quartz-sulphide veins. Sampling focused on historical workings and returned results up to 50 g/t Au, 11.5% Zn and 13.9% Pb.
Nickel Mountain	Garibaldi Resources Corp.	Ni, Cu, Co, Pt, Pd, Au, Ag; tholeiitic intrusion; 104B 006	na	Diamond drilling (32 holes, 11,573 m). Highlight results for 10 holes include 30.5 m of 3.10% Ni, 1.86% Cu, 0.081% Co, 0.863 g/t Pt, 1.776 g/t Pd, 0.739 g/t Au, 7.3 g/t Ag and 5.6 m of 7.60% Ni, 3.36% Cu, 0.198% Co, 0.668 g/t Pt, 0.814 g/t Pd, 0.466 g/t Au, 9.0 g/t Ag.
Ootsa	Surge Copper Corp.	Cu, Au, Ag, Mo; porphyry; 093E 105	I: 67.76 Mt 0.21% Cu, 0.17 g/t Au, 0.015% Mo, 2.01 g/t Ag Inf: 410.88 Mt 0.16% Cu, 0.11 g/t Au, 0.018% Mo, 1.95 g/t Ag	A new copper zone discovered 500 m northeast of the East Seel deposit. Continuous mineralization (202 m) assayed 0.26% Cu, 0.31 g/t Au and 1.32 g/t Ag. A later hole intersected 22 m of 0.5% Cu, 0.10 g/t Au, 17.6 g/t Ag, 0.65% Zn and 0.14% Pb. Drilling between the East Seel and Damascus deposits intersected a new gold zone returning 2 m grading 9.4 g/t Au.
Pearson	Teuton Resources Corp.	Cu, Ag, Au; polymetallic veins	na	A grab sample from a 70 cm wide mineralized quartz vein returned 54.5 g/t Au, 87.8 g/t Ag and 7.54% Pb.

Table 4. Continued.				
Pitman	Casa Minerals Inc.	Au, Ag, Cu, Pb, Zn; polymetallic veins	na	New showings, Golden Dragon and Dragon Tale, discovered in 2018. Rock chip sampling at Golden Dragon returned 0.6 m assaying 574.42 g/t Au, 109 g/t Ag, 0.1% Cu, 1.56% Pb, 0.23% Zn and 0.9 m assaying 268.86 g/t Au, 127 g/t Ag, 0.2% Cu, 2.95% Pb, 0.04% Zn. The Dragon Tale showing returned rock sample assays as high as 231 g/t Ag and 6.15% Zn.
Porter	StrikePoint Gold Inc.	Ag, Au, Cu, Zn; polymetallic veins	na	StrikePoint Gold acquired the property from Skeena Resources Limited in July and carried out diamond drilling (4800 m), prospecting, and sampling. Thirty-two rock samples returned assays ranging from trace to 43.6 oz/t Ag, trace to 0.54 oz/t Au and trace Zn to 28.8%. A new mineralized vein was discovered with a 205 m strike length and widths of up to 2 m. Samples graded up to 876 g/t Ag and 10.8 g/t Au.
Premier East	Decade Resources Ltd.	Au, Ag, Cu; polymetallic veins	na	Rock sampling returned anomalous values for precious and base metals including one sample that graded 5.72 g/t Au, 716 g/t Ag and 11.60% Cu.
Premier/Dilworth	Ascot Resources Ltd.	Au, Ag; Au in quartz veins; 104B 044	I: 2.78 Mt grading 7.46 g/t Au and 26.2 g/t Ag (Premier/ Northern Lights, Big Missouri, Silver Coin and Martha Ellen deposits) Inf: 6.03 Mt grading 7.18 g/t Au and 24.0 g/t Ag (Premier/ Northern Lights, Big Missouri, Silver Coin, Martha Ellen and Dilworth deposits)	Diamond drilling 45,800 m. Results included 20.0 m of 8.04 g/t Au and 21.4 g/t Ag at the western extension of Premier, 7.2 m of 20.67 g/t Au and 24.92 g/t Ag at the Big Missouri zone, and 12.38 m of 8.91g/t Au and 22.9 g/t Ag at the North Star prospect. In December, an updated resource estimate was released.
RD	Primary Energy Metals Inc.	Au, Co, Cu; VMS	na	Detailed mapping and sampling. A total of 85 rock samples and 287 soil samples were collected. Highlight rock sample results included a 0.25 m chip sample returning 20 g/t Au, 0.194% Co and a grab sample returning 18.7 g/t Au, 0.653% Co, 0.969% Cu.
Red Cliff	Decade Resources Ltd. (65%), (Mountain Boy Minerals Ltd. (35%))	Cu, Au, Ag, Zn; polymetallic veins; 104A 037	na	A 53 hole, 11,000 m diamond drilling program carried out. Drilling results for the Waterpump zone included 4.54 m of 12.11 g/t Au and 7.26 m of 10.6 g/t Au.
Schaft Creek	Teck Resources Limited (75%), (Copper Fox Metals Inc. (25%))	Cu, Au; calc-alkalic porphyry; 104G 015	1.229 Bt at 0.26% Cu, 0.017% Mo, 0.19g/t Au, 1.69 g/t Ag	Collection of environmental base line data, ongoing First Nations consultation.

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Table 4. Continued.

Silver Coin	Ascot Resources Ltd.	Ag, Zn, Pb, Cu; intrusion- related Au pyrrhotite veins, subaqueous hot spring Ag, Au, polymetallic veins; 104B 095	na	Purchased by Ascot in October from Jayden Resources Inc. (80%) and Mountain Boy Minerals Ltd. (20%). The project is 800 m from Ascot's Big Missouri deposit and 5 km from the historic Premier mine mill, also owned by Ascot.
Silver Hope	Finlay Minerals Ltd.	Cu, Au, Ag; porphyry, subvolcanic Cu-Ag-Au; 093L 001, 373, 374, 256	na	Deep-penetrating induced polarization and magnetotelluric geophysical surveys to define new drill targets.
Silver Queen	New Nadina Explorations Ltd.	Ag, Cu, Au, Zn, Pb; polymetallic veins; 093L 002	na	Three diamond drill holes totalling 3053 m to test an induced polarization conductivity anomaly. Results did not explain the anomaly.
Silver Vista	Glacier Lake Resources Inc.	Au, Cu, Zn; polymetallic veins	na	Seven diamond drill holes (1273 m). Silver- copper mineralization in all holes, including 153.4 m grading 16.1 g/t Ag, 0.05% Cu and 0.10% Zn.
Snip	Skeena Resources Limited	Au, Ag; mineralized quartz veins; 104B 250	na	Underground and surface drilling (46 holes, 7732 m). Results included 13.8 g/t Au over 18.00 m. In October, Skeena granted Hochschild Mining Holdings Limited an option to acquire 60% of the project.
Stars	ML Gold Corp.	Cu, Au, Ag, Mo; porphyry	na	Reported that drilling at two new targets intersected mineralized porphyry. In February, they announced 204 m assayed 0.45% Cu, 0.045 g/t Au, 1.64 g/t Ag, 0.0048% Mo. In August, they announced 405 m assayed 0.20% Cu, 0.0082% Mo, 0.754 g/t Ag and 24 ppb Au.
Surprise Creek	Mountain Boy Minerals Ltd.	Barite, Zn, Pb, Ag; VMS	na	2017 drilling results reported in 2018. Drilling intersected a barite cap. Results included 15 m of 66.8% and 26 m of 41% $BaS0_4$ including 4.5 m grading 3.27% Zn, 0.71% Pb and 22 g/t Ag.
Tatogga (Saddle North)	GT Gold Corp.	Au, Ag, Cu; porphyry; 104G 432	na	New porphyry Cu-Au-Ag discovery. Initial drilling highlights included 430 m of 0.67 g/t Au, 0.41% Cu and 0.89 g/t Ag. A later hole, approximately 200 m to the northwest, returned 363 m of 1.02 g/t Au, 0.51% Cu and 1.72 g/t Ag in 904 m of 0.51 g/t Au, 0.30% Cu and 0.93 g/t Ag.
Tatogga (Saddle South)	GT Gold Corp.	Au, Ag, Cu; epithermal Au-Ag, low sulphidation; 104G 433	na	Gold-silver mineralized zones were extended along strike. Additional high- grade Au mineralization at depth. Drilling highlights included 40.89 m of 9.55 g/t Au.

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Tenas	Allegiance Coal Limited (80%) (Itochu (20%))	Bituminous coal; 093L 156	M: 89.113 Mt I: 42.037 Mt Inf: 33.412 Mt	Drilling program for geotechnical information, installing water monitoring wells and collecting samples for geochemical and coal testing studies. 1400 kg of coal sent for sizing, washability, and comprehensive coal quality analyses and to generate samples for coke oven tests. In November, it was announced that Itochu Corporation of Japan (Itochu) was investing in the project. A definitive feasibility study was expected in early 2019.
Thorn	Brixton Metals Corporation	Ag, Au, Cu, Pb, Zn; subvolcanic; 104K 031	Inf: 7.4 Mt at 35.54 g/t Ag, 0.51 g/t Au, 0.13% Cu, 0.32% Pb, 0.59% Zn	Core re-logging, geological mapping, and sampling for whole rock lithogeochemical analysis. Short-wave infrared spectroscopy carried out.
Todd Creek	Sojourn Exploration Inc.	Cu, Au, Ag, Pb, Zn; polymetallic veins	na	Samples from the Yellow Bow zone averaged 0.68% Cu, including 10 samples with over 1% Cu. Samples from the Fall Creek zone returned up to 37.7 g/t Au and 5.3% Cu. Eight samples from the VMS zone averaged 0.213 g/t Au, 30.1 g/t Ag, 0.53% Pb, 2.54% Zn including individual assays up to 1.98% Cu, 9.15% Zn, 0.392 g/t Au and 112 g/t Ag.
Treaty Creek	Tudor Gold Corp. (60%), (Teuton Resources Corp. (20%), American Creek Resources Ltd. (20%))	Au, Ag; epithermal high sulphidation; 104B 078	na	Diamond drilling (nine holes, 7200 m) targeting the Copper Belle zone. Highlight results included 121.8 m of 1.04 g/t Au with a high-grade interval of 26.6 g/t Au over 1.5 m.
Turnagain	Giga Metals Corp.	Ni, Co; Alaskan-type; 104I 014	M+I: 865 Mt at 0.21% Ni, 0.013% Co Inf: 976 Mt at 0.2% Ni, 0.013% Co	Diamond drilling (40 holes, 10,835 m) to test new targets, infill, collect metallurgical samples and geotechnical information for pre-feasibility study.

 Table 4. Continued.

M = Measured; I = Indicated; Inf = Inferred

Advanced-stage activities concentrate on the delineation of a mineral resource. The mine evaluation stage concentrates on the environmental, social, engineering and financial evaluation of a proposed mine. Selected exploration projects active during 2018 are summarized in Table 4 and shown on Figure 1.

6.1. Selected precious metal projects

Precious metal projects in the Northwest Region were generally concentrated in the Stewart area and in the Lower Iskut River area. Multiple drilling programs continued to test new targets and extend known mineralization.

6.1.1. Atlin Gold Project (Brixton Metals Corporation)

Since 2016, Brixton has staked claims and completed transactions to secure approximately 1000 km² of mineral rights for the **Atlin Gold** project. The project area is east of

the town of Atlin and is road accessible. In 2018, Brixton conducted geological mapping, rock and chip sampling, and biogeochemical studies, and collected 2500 soil samples over selected areas. Several gold-in-soil anomalies were defined.

6.1.2. Engineer (Engineer Gold Mines Ltd.)

The **Engineer** project includes the historic Engineer gold mine on Tagish Lake, 32 km southwest of Atlin. The project has a Mines Act permit authorizing exploration, underground mining and on-site milling activities. In the fall, Engineer Gold Mines completed a MMI soil sampling survey over the core patented crown grants and the immediate mine area. Results were expected in early 2019. In preparation for a 2019 work program, the company barged loads of heavy equipment, fuel and diamond drill equipment to the mine site.

6.1.3. Forest Kerr (Aben Resources Ltd.)

The first drill hole of 2018 at the North Boundary zone (NBZ), part of Aben Resources Ltd.'s **Forest Kerr** project, intersected multiple high-grade zones including 38.7 g/t Au over 10.0 m (Fig. 2). Subsequent holes also returned high-grade gold assays. Mineralization at the NBZ is structurally controlled and hosted in a package of volcanic and volcaniclastic rocks of the Hazelton Group. The company also discovered a new mineralized zone (South Boundary zone), about 1.5 km south of the NBZ. Drilling intersected quartz veins with abundant pyrite and chalcopyrite and returned Au assays ranging from trace amounts to greater than 5 g/t in the 1 or 2 m sample intervals (Ag values ranged from trace to 8.7 g/t and Cu values range from trace to 9500 ppm).



Fig. 2. Visible gold in drill core from Aben Resources Ltd.'s Forest Kerr project. Photo courtesy of Aben Resources Ltd.

6.1.4 Kirkham (Metallis Resources Inc.)

In 2018, Metallis carried out the first ever drill programs at the Cole and Nina targets of the **Kirkham** project. Although these are porphyry Cu-Au targets, drilling at Cole intersected an intrusion-related massive sulphide pyrite-pyrrhotite vein that assayed 11.18 g/t Au over 7.7 m.

6.1.5. Premier/Dilworth (Ascot Resources Ltd.)

At their **Premier/Dilworth** project, Ascot Resources Ltd. drilled an additional 45,800 m in 2018, following up on 140,000 m of drilling in 2017. Results reported included 20.0 m of 8.04 g/t Au and 21.4 g/t Ag at the western extension of Premier, 7.2 m of 20.67 g/t Au and 24.92 g/t Ag at the Big Missouri zone, and 12.38 m of 8.91g/t Au and 22.9 g/t Ag at the North Star prospect. In December, the company released an updated resources estimate. For the Premier/Northern Lights, Big Missouri, Silver Coin and Martha Ellen deposits, total Indicated resources are 2.78 Mt grading 7.46 g/t Au and 26.2 g/t Ag. For the Premier/Northern Lights, Big Missouri, Silver Coin, Martha Ellen and Dilworth deposits, Inferred resources are 6.03 Mt grading 7.18 g/t Au and 24.0 g/t Ag.

6.1.6. Red Cliff (Decade Resources Ltd. 65%, Mountain Boy Minerals Ltd. 35%)

In 2018, a 53 hole 11,000 m diamond drilling program was carried out on the **Red Cliff** project. Drilling results for the Waterpump zone included 4.54 m of 12.11 g/t Au and 7.26 m of 10.6 g/t Au.

6.1.7. Silver Coin (Ascot Resources Ltd.)

The **Silver Coin** project was purchased by Ascot in October from Jayden Resources Inc. (80%) and Mountain Boy Minerals Ltd. (20%). The project is 25 km north of Stewart, 800 m from Ascot's Big Missouri deposit and 5 km from the historic Premier mine mill, also owned by Ascot. It is an advanced stage epithermal gold-silver project with a historical mineral resource estimate for the high-grade core of the orebody of 702,000 t grading 4.46 g/t Au in the Indicated category and 967,000 t grading 4.39 g/t Au in the Inferred category. Ascot considers there is potential for expansion of the mineralized zones and potential for discovering additional zones.

6.1.8. Snip (Skeena Resources Limited)

Skeena Resources Ltd. continued with underground and surface drilling at their past-producing **Snip** gold mine project, completing 7732 m in 46 holes. Results included 13.8 g/t Au along 18.0 m. In October it was announced that Skeena granted Hochschild Mining Holdings Limited (a wholly owned subsidiary of Hochschild Mining plc) an option to acquire 60% of the project. Hochschild has three years to provide notice that they will exercise the option. After notification they have three years to meet expenditure commitments.

6.1.9. Tatogga (Saddle South) (GT Gold Corp.)

The **Tatogga** project is approximately 14 km west of the Red Chris copper-gold mine, less than 1 km west of Iskut, and close to a paved road (Highway 37). In 2018, GT Gold Corp. extended Saddle South gold-silver mineralized zones along strike and identified additional high-grade gold mineralization at depth. Drilling highlights included 40.89 m of 9.55 g/t Au. Saddle South, discovered in 2017, is the project's first high-grade epithermal vein occurrence. In 2018, GT Gold made a large porphyry Cu-Au-Ag discovery on the adjacent Saddle North target (see section 6.2.11.).

6.1.10. Treaty Creek (Tudor Gold Corp. 60%, Teuton Resources Corp. 20%, American Creek Resources Ltd. 20%)

The **Treaty Creek** project is adjacent to Seabridge's KSM project and Pretium's Brucejack mine. In 2018, Tudor drilled 7200 m in nine holes. The target was the Copper Belle zone and highlight results included 121.8 m of 1.04 g/t Au with a high-grade interval of 26.6 g/t Au over 1.5 m.

6.2. Selected porphyry projects

The Northwest Region is highly prospective for porphyry deposits related to island arc assemblages accreted to North America and to post-accretionary intrusive suites.

6.2.1. Berg (Centerra Gold Inc.)

The **Berg** project is approximately 20 km northwest of the Huckleberry mine and contains the Berg porphyry Cu-Mo-Ag deposit. In 2018, Centerra carried out mapping and sampling

in the Berbette and A12 target areas. Soil sampling was carried out at A12.

6.2.2. Boomerang (Hawkeye Gold and Diamonds Inc.)

Soil sampling at the **Boomerang** project in 2018, coupled with historical soil surveys, outlined an approximately 500 m by 1500 m anomaly, with most values ranging between 100 and 1225 ppm Cu.

6.2.3. Duke (Amarc Resources Ltd.)

The **Duke** property straddles the Northwest and North Central regions. The property includes a porphyry Cu +/-Mo deposit that was the subject of an historic (NI 43-101 non-compliant) inferred resource estimated at 40.8 million tons at 0.25% Cu and 0.01% Mo. Amarc drilled six holes, totalling 3060 m to follow up on 2017 results. Seven of the eight holes drilled in 2017 and 2018 intersected porphyry Cu-Mo-Ag mineralization. Highlight results from 2018 included 348 m grading 0.23% Cu, 0.013% Mo, 1.1 g/t Ag, 0.05 g/t Au.

The property was explored intermittently between 1965 and 2010 by IP and magnetic surveys, and by shallow drilling, and was acquired by Amarc in 2016. Results to date suggest currently defined mineralization is open in all directions.

6.2.4. Hank (Golden Ridge Resources Ltd.)

Golden Ridge Resources Ltd. announced discovering a new porphyry Cu-Au at the Williams zone of their **Hank** project. Their first drill hole intersected 327 m grading 0.31% Cu, 0.35 g/t Au and 1.94 g/t Ag. Additional drilling returned similar grades, and the company expanded induced polarization survey coverage.

6.2.5. Hat (Doubleview Capital Corp.)

The **Hat** project contains the Lisle Au-Cu alkali porphyry zone. In 2018, Doubleview Capital Corp. optioned the project to Hudbay Minerals Inc. Hudbay will be the operator and has the right to earn up to 65% interest by fulfilling the terms of a three-stage agreement that includes expenditures of \$40 million and costs for a feasibility study. In the summer, a 40 line-km, deep-penetrating induced polarization survey was carried out to target the depth, shape, structure, and dimensions of goldcopper mineralization and to delineate drilling targets.

6.2.6. Iskut (Seabridge Gold Inc.)

In 2018, Seabridge carried out 2700 m of diamond drilling on the Quartz Rise target at the **Iskut** project. The program was designed to test for high-grade epithermal precious metal mineralization but encountered mineralization typical of a large porphyry Cu-Au system. Drilling intersected a hydrothermal breccia containing abundant clasts of chalcopyrite, pyrite, and magnetite in veined intrusive rocks and stockworks positioned over a large IP chargeability anomaly interpreted as representing a sulphide-rich porphyry intrusion.

6.2.7. Kinaskan-Castle (Colorado Resources Ltd.)

Colorado Resource's **Kinaskan-Castle** project is 25 km west of the Red Chris mine and 1 km west of GT Gold Corp.'s Tatogga project. In 2018, Colorado extended induced polarization survey coverage on the property that produced chargeability anomalies coincident with large gold and copper soil geochemical anomalies, which extend along an east-west trend for more than 2000 m. The anomalies are interpreted to be in the same rock units that host the Saddle North and Saddle South discoveries on the Tatogga property. In October, Colorado received permits to allow drilling and a program is planned for 2019.

6.2.8. Ootsa (Surge Copper Corp.)

Surge Copper Corp.'s (formerly Gold Reach Resources Ltd.) **Ootsa** project is adjacent to the past-producing Huckleberry mine and mill complex. In 2018, Surge Copper discovered a new copper zone (Fig. 3) 500 m northeast of their East Seel deposit. The discovery hole intersected 202 m of continuous mineralization and assayed 0.26% Cu, 0.31 g/t Au and 1.32 g/t Ag. A later hole intersected 22 m of 0.5% Cu, 0.10 g/t Au, 17.6 g/t Ag, 0.65% Zn and 0.14% Pb. Drilling an uplifted fault block between the East Seel and Damascus deposits intersected a new gold zone returning a 2 m intersection grading 9.4 g/t Au.



Fig. 3. Chalcopyrite and pyrite mineralization, hole S18-214, Surge Copper Corp.'s Ootsa project. Photo courtesy of Surge Copper Corp.

6.2.9. Schaft Creek (Teck Resources Limited 75% and Copper Fox Metals Inc. 25%)

The **Schaft Creek** porphyry Cu-Au-Mo is an advanced-stage project. In 2018, the companies continued environmental base line studies and First Nations consultations. The project consists of three deposits: the Main (Liard) zone, The Paramount zone and the West Breccia zone. A 2013 feasibility study defined a Proven and Probable reserve of 940.8 Mt grading 0.27% Cu, 0.19 g/t Au, 0.018% Mo and 1.72 g/t Ag. Measured and Indicated resources were listed as 1,228.6 Mt grading 0.26% Cu, 0.017% Mo, 0.19 g/t Au and 1.69 g/t Ag and a 597.2 Mt

Inferred resource grading 0.22% Cu, 0.016% Mo, 0.17 g/t Au and 1.65 g/t Ag. Proven and Probable reserves are included within the stated Measured and Indicated resources.

6.2.10. Silver Hope (Finlay Minerals Ltd.)

In 2018, Finlay carried out deep-penetrating induced polarization and magnetotelluric geophysical surveys at the **Silver Hope** property to define new drill targets.

6.2.11. Stars (ML Gold Corp.)

ML Gold Corp. reported that drilling at two new targets on their **Stars** project intersected mineralized porphyry. In February, they announced 204 m assayed 0.45% Cu, 0.045 g/t Au, 1.64 g/t Ag, 0.0048% Mo. In August, they announced 405 m assayed 0.20% Cu, 0.0082% Mo, 0.754 g/t Ag and 24 ppb Au.

6.2.12. Tatogga (Saddle North) (GT Gold Corp.)

GT Gold Corp.'s **Tatogga** project is approximately 14 km west of the Red Chris copper-gold mine, close to a paved road (Highway 37). The project has two target areas, Saddle South and Saddle North. Saddle South is a high-grade gold discovery made in 2017 (in section 6.1.9.). In 2018, GT Gold reported discovering a new Cu-Au-Ag porphyry at the Saddle North target, approximately 1.5 kilometres east-northeast of the Saddle South gold discovery. Initial drilling highlights included 430 m of 0.67 g/t Au, 0.41% Cu and 0.89 g/t Ag. A later hole, approximately 200 m to the northwest, returned 363 m of 1.02 g/t Au, 0.51% Cu and 1.72 g/t Ag in 904 m of 0.51 g/t Au, 0.30% Cu and 0.93 g/t Ag.

6.2.13. Thorn (Brixton Metals Corporation)

The Chivas zone porphyry Cu-Au-Mo target is part of Brixton Metals' **Thorn** project. In 2018, Brixton completed a program of core re-logging, geological mapping and sample collecting for whole rock lithogeochemical analysis combined with short-wave infrared spectroscopy.

6.3. Selected polymetallic base and precious metal projects

The Northwest Region hosts many significant base and precious metal deposits, a number of which were explored in 2018.

6.3.1. Brucejack Regional (Pretium Resources Inc.)

Beyond the Brucejack mine area, Pretium continued to evaluate their surrounding 1250 km² of mineral claims. The **Brucejack Regional** project includes the American Creek, Bluffy, and Koopa zones, along with the newly discovered Upper Kirkham zone. The company carried an 8000 m drilling program along with mapping and prospecting. At the American Creek zone, drilling highlight results included 1.5 m grading 10.15 g/t Au and 25.5 m grading 41.54 g/t Ag, 2.12% Zn and 0.56% Pb. Prospecting sample results located the new Upper Kirkham zone. Samples returned assays as high as 3.55 g/t Au,

greater than 10,000 g/t Ag, 4.71% Cu, greater than 20% Pb and 3.81% Zn.

6.3.2. Clone Gold (Sunvest Minerals Corp.)

At the **Clone Gold** project Sunvest carried out geochemical rock, silt, and soil sampling, and packsack drilling in 2018. Recent ice retreat has resulted in new bedrock exposure and the company also carried out detailed geological mapping. Sampling at the Port 19 showing returned Cu values of 0.52%, 0.99%, 1.02% and 1.64% and a Ag assay of 220 g/t. Sampling at the Outbound showing returned multiple rock samples returning in excess of 0.10% Cu and a peak value of 0.56% Cu and up to 132 g/t Ag, and gold values in soil samples up to 1.04 g/t Au.

At the Clone prospect, sampling returned values including 10.9 g/t Au, and 0.64% Cu in rock samples, and peak values of 1.26 g/t Au and 1.66 g/t Au from soil samples. A new mineralized vein (Southern Glory prospect) was also announced. A quartz vein, up to 1.25 m wide, was mapped along a strike length of about 70 m. Results included a 1 m chip sample returning 4.11% Cu, 160 g/t Ag, 0.52g/t Au.

6.3.3. Dolly Varden (Dolly Varden Silver Corporation)

Dolly Varden Silver's **Dolly Varden** project consists of the Torbrit, Dolly Varden, Wolf, and North Star deposits and a number of mineralized zones. In 2018, Dolly Varden drilled 29,108 m in 84 holes and discovered a new zone (Bonus zone). Drilling results included 15.50 m grading 161.4 g/t Ag, 0.25% Pb and 0.20% Zn. Drilling on known zones included 24.00 m grading 287.5 g/t Ag, 0.29% Pb, and 0.11% Zn at Torbrit East and 29.15 m grading 226.0 g/t Ag, 0.09% Pb, and 0.13% Zn at the Moose-Lamb zone.

6.3.4. Dunwell (American Creek Resources Ltd.)

American Creek's **Dunwell** project contains the historic Dunwell gold-silver-lead-zinc mine. American Creek believes potential exists to develop more reserves along strike and below the original workings. In 2018, American Creek collected 30 rock samples from various locations, both at surface and underground. Reported results included high-grade Au (up to 61.2 g/t) and Ag (up to 1186 g/t) along with base metals.

6.3.5. Eskay Creek (Skeena Resources Limited)

The **Eskay Creek** project was acquired in late 2017 by Skeena Resources from Barrick Gold Inc. and includes the former producing Eskay Creek mine. In 2018, Skeena carried out diamond drilling, compiled and reviewed 20 years of exploration and production information, and completed a geologic model and resource estimate. The pit-constrained Indicated resource estimate is 1.08 Mt at 4.9 g/t Au, 72 g/t Ag, and the Inferred resource is 4.26 Mt at 3.3 g/t Au, 72 g/t Ag. The underground Indicated resource is 2.51 Mt at 7.2 g/t Au, 215 g/t Ag, and the underground Inferred resource is 0.81 Mt at 7.2 g/t Au, 214 g/t Ag. Lead, copper, zinc and antimony are

potential by-products worth incorporating into future mineral resource estimates.

Drilling highlights from 2018 include 14.55 m grading 7.36 g/t Au, 1,189 g/t Ag and 31.50 m grading 10.16 g/t Au, 331 g/t Ag and 42.65 m grading 9.49 g/t Au, 111 g/t Ag.

6.3.6. Golddigger (Goliath Resources Limited)

Goliath reported discovering multiple breccias, stockworks, and veins containing high-grade gold and polymetallic mineralization at the **Golddigger** project. A 0.55 m channel sample graded 29.70 g/t Au and 14.30 g/t Ag, a 0.50 m chip sample graded 47.50 g/t Au and 272.00 g/t Ag and grab samples graded up to 113.50 g/t Au and 249.00 g/t Ag. This new gold-enriched polymetallic discovery is in an extensive area where glacier retreat and snow pack loss has increased bedrock exposure.

6.3.7. Keaper (Casa Minerals Inc.)

At the **Keaper** project, Casa collected 85 rock samples and 580 soil samples in 2018. Highlight rock sample results include 1512 g/t Ag with 0.88% Cu, 1.19% Pb, 13.9% Zn and >100 g/t Ag with 0.33% Cu.

6.3.8. Kinskuch (Hecla Mining Company)

Hecla reports that 2018 drilling at the **Kinskuch** project defined silver-enriched base metal mineralization along a strike length of 4.8 km and that high-grade zones appear to have continuity. These zones may represent two parallel structures or the limbs of a folded body. Although assay results were not mentioned, Hecla reported that they plan to produce a preliminary resource model.

6.3.9. Kutcho (Kutcho Copper Corp.)

Kutcho Copper Corp.'s **Kutcho** project is at an advanced stage. A preliminary feasibility study from 2017 reports a Probable reserve of 10.4 Mt at 2.01% Cu, 3.19% Zn, 34.61 g/t Ag, and 0.37 g/t Au. At a 1.0% copper cut off, combined Measured and Indicated resources are estimated at 16.853 Mt of 1.89% Cu, 2.87% Zn, 0.36 g/t Au and 32.8 g/t Ag. In 2018, Kutcho carried out a comprehensive review of historic data to identify targets for drilling. Results of this drilling included 28 m of 2.09% Cu, 6.1% Zn, 65.8 g/t Ag, 0.82 g/t Au and 5.4 m of 2.48% Cu, 1.0% Zn, 114.0 g/t Ag, 0.24 g/t Au. A bench-scale metallurgical study is underway and a feasibility study is scheduled for 2019.

6.3.10. KSP (Colorado Resources Ltd.)

In 2018, Colorado diamond drilled 7847 m in 35 holes at the **KSP** property. Drilling tested step out targets near the historic Inel basin area, including the Big Rock Deformation zone (BRDZ) to the east, and the Inel zone to the north. Results included 32 m grading 0.32 g/t Au and 1.64% Zn and 50 m grading 2.28 g/t Au, including 6 m grading 7.36 g/t Au.

6.3.11. Maroon (Gitennes Exploration Inc.)

In 2018, Gitennes carried out reconnaissance prospecting and sampling at the **Maroon** project, and found several polymetallic quartz-sulphide veins. Sampling focussed on historical workings and returned results up to 50 g/t Au, 11.5% Zn and 13.9% Pb.

6.3.12. Pearson (Teuton Resources Corp.)

Teuton's **Pearson** project is approximately 20 km south southwest of Seabridge's KSM property. In 2018, diamond drilling of three holes (512 m) failed to reach intended target depths, but a grab sample from a 70 cm wide mineralized quartz vein returned 54.5 g/t Au, 87.8 g/t Ag and 7.54% Pb.

6.3.13. Pitman (Casa Minerals Inc.)

The **Pitman** project includes previously known target areas including Gold Dome and Pitman, and 2018 discoveries, Golden Dragon, Dragon Tale. Rock chip sampling at Golden Dragon returned 0.6 m assaying 574.42 g/t Au, 109 g/t Ag, 0.1% Cu, 1.56% Pb, 0.23% Zn and 0.9 m assaying 268.86 g/t Au, 127 g/t Ag, 0.2% Cu, 2.95% Pb, 0.04% Zn. The Dragon Tale showing is about 1 km from Golden Dragon and rock sampling returned assays as high as 231 g/t Ag and 6.15% Zn.

6.3.14. Porter (StrikePoint Gold Inc.)

The **Porter** project is within 4 km of Stewart and contains the historic Silverado mine, the historic Handsome Jack workings, the Porter historic resource area, the Big Nunatak showing and the Glacier Creek property. Having acquired the property from Skeena Resources Limited in July, StrikePoint Gold Inc. carried out diamond drilling (4800 m), prospecting, and sampling. Glacier retreat has exposed a new mineralized vein along a 275 m strike length near the historic Porter resource. Thirty two samples were collected, with assays ranging from trace to 43.6 oz/t Ag, trace to 0.54 oz/t Au and trace Zn to 28.8%. Sampling at Big Nunatak returned up to 427 g/t Ag and 0.78% Cu. At the glacier Creek property, 5.5 km northeast of the Porter mine site, a new mineralized vein was discovered with a 205 m strike length and widths of up to 2 m. Samples graded up to 876 g/t Ag and 10.8 g/t Au.

6.3.15. Premier East (Decade Resources Ltd.)

Decade Resources carried out rock sampling on its **Premier East** project, adjacent to the historic Premier gold-silver mine. Results returned anomalous values for precious and base metals, including one sample that graded 5.72 g/t Au, 716 g/t Ag and 11.60% Cu.

6.3.16. Silver Queen (New Nadina Explorations Ltd.)

At the **Silver Queen** project, New Nadina drilled three holes totalling 3053 m to test an induced polarization conductivity anomaly. Results did not explain the anomaly, but additional drilling is planned for 2019.

6.3.17. Silver Vista (Glacier Lake Resources Inc.)

Glacier Lake completed seven diamond drill holes totalling 1273 m at the **Silver Vista** project. Silver-copper mineralization was encountered in all holes, including 153.4 m grading 16.1 g/t Ag, 0.05% Cu and 0.10% Zn.

6.3.18. Surprise Creek (Mountain Boy Minerals Ltd.)

In January 2018, Mountain Boy reported results for drilling carried out in 2017 at the **Surprise Creek** project. Drilling intersected a barite cap, which is common in Kuroko-style VMS deposits. Results included 15 m of 66.8% and 26 m of 41% BaS0₄ including 4.5 m grading 3.27% Zn, 0.71% Pb and 22 g/t Ag.

6.3.19. Todd Creek (Sojourn Exploration Inc.)

In 2018, Sojourn carried out rock and chip sampling at the **Todd Creek** project. Samples from the Yellow Bow zone averaged 0.68% Cu, including 10 samples with more than 1% Cu. Samples from the Fall Creek zone returned up to 37.7 g/t Au and 5.3% Cu. Eight samples from the VMS zone averaged 0.213 g/t Au, 30.1 g/t Ag, 0.53% Pb, 2.54% Zn including individual assays up to 1.98% Cu, 9.15% Zn, 0.392 g/t Au and 112 g/t Ag.

6.4. Selected cobalt projects

An increase in the price for cobalt resulted in a number of cobalt specific-projects being undertaken in the province, including the RD project in the Northwest Region.

6.4.1. RD (Primary Energy Metals Inc.)

The **RD** project is about 1 km south of Hazelton. Primary Energy carried detailed mapping and sampling of the Golden Wonder showing. A total of 85 rock samples and 287 soil samples were collected. Highlight rock sample results included a 0.25 m chip sample returning 20 g/t Au, 0.194% Co and a grab sample returning 18.7 g/t Au, 0.653% Co, 0.969% Cu.

6.5. Selected mafic and ultramafic hosted projects

The Northwest Region has several ultramafic-hosted metallic prospects, including intrusion-hosted and serpentinite-hosted nickel occurrences.

6.5.1. Nickel Mountain (Garibaldi Resources Corp.)

Garibaldi Resources Corp.s' **Nickel Mountain** project is located approximately 90 km northwest of Stewart. In 2018, Garibaldi carried out a 32 hole 11,573 m diamond drilling program. Highlight results for 10 holes include 30.5 m of 3.10% Ni, 1.86% Cu, 0.081% Co, 0.863 g/t Pt, 1.776 g/t Pd, 0.739 g/t Au, 7.3 g/t Ag and 5.6 m of 7.60% Ni, 3.36% Cu, 0.198% Co, 0.668 g/t Pt, 0.814 g/t Pd, 0.466 g/t Au, 9.0 g/t Ag. Results for the remaining 22 holes are pending. Additional drilling in 2019 is planned.

6.5.2. Turnagain (Giga Metals Corp.)

Giga Metals Corp. carried out a 40-hole 10,835 m diamond

drill program at their **Turnagain** project. The program was designed to test new targets, provide infill, collect samples for metallurgical testing, and yield geotechnical information to support pre-feasibility studies. The project has Measured and Indicated resources of 865 Mt at 0.21% Ni, 0.013% Co, and an additional Inferred resource of 976 Mt at 0.2% Ni, 0.013% Co.

6.5.3. Kirkham (Thunder North) (Metallis Resources Inc.)

The Thunder North target of Metallis's **Kirkham** project is approximately 2 km southeast from Garibaldi Resource's Nickel Mountain project. In the fall, Metallis announced that diamond drilling to test airborne electromagnetic and magnetic targets was underway.

6.6. Selected coal projects

The Northwest Region contains the Tuya, and Telkwa coalfields and part of the Groundhog-Klappan coalfield, which are prospective for anthracite coal deposits.

6.6.1. Tenas (Allegiance Coal Limited 80%, Itochu 20%)

In 2018, Allegiance Coal Limited continued to move the **Tenas** project forward through their wholly owned subsidiary Telkwa Coal Limited. Eight PQ diameter holes were drilled, three for the installation of water monitoring wells and five to collect rock samples for geochemical studies and coal testing. Twelve sonic holes were drilled for geotechnical information. Fourteen large diameter (150 mm) holes were drilled, recovering 1400 kg of coal. The coal was sent for sizing, washability, and comprehensive coal quality analyses and to generate samples for coke oven tests. In November it was announced that Itochu Corporation of Japan (Itochu) was investing in the project. A definitive feasibility study was expected in early 2019.

7. Geological research

van Straaten and Wearmouth (2019) reported on the third and final field season of a mapping project in the Dease Lake area that examined Upper Triassic to Middle Jurassic arcrelated volcanic and sedimentary rocks and allied intrusive rocks to better understand the tectonic and metallogenic history of northern Stikinia and bounding terranes. Working with archived samples, Mihalynuk et al. (2019) reported U-Pb zircon ages from the Granduc and Rock and Roll volcanic massive sulphide deposits that are consistent with previous work indicating that mineralization took place in the Late Triassic. Lett (2018) released the results from a previously unpublished moss mat-sediment geochemical survey from the Porcher Island, Grenville Channel, and Dundas Island area, central British Columbia coast. The MDO office co-ordinated the production of a brochure intended for a popular audience and devoted to the Golden Triangle of the Northwest Region (British Columbia Geological Survey, 2018).

8. Summary

The Northwest Region is highly prospective for discovering mineral deposits. The region has a number of advanced and proposed mine projects. The region also has numerous active exploration projects, primarily for precious and base metals. In 2018, exploration activity increased for the second year in a row. Exciting new results were announced for established projects and a number of new discoveries were made.

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