

Exploration and mining in the South Central Region, British Columbia



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Recommended citation: Northcote, B., 2018. Exploration and mining in the South Central Region, British Columbia. In: Provincial Overview of Exploration and Mining in British Columbia, 2017. British Columbia Ministry of Energy, Mines and Petroleum Resources, British Columbia Geological Survey Information Circular 2018-1, pp. 85-103.

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, infrastructure, and access to markets have made it an important industrial minerals centre as well. 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, and 80 exploration projects were tracked in 2017, although the number of mineral properties with some level of activity was likely greater.

For the South Central region, exploration expenditures are estimated to be \$61.1 million; exploration drilling is estimated at 237,600 m (Clarke et al., 2018; Ernst & Young LLP, in press). This represents a significant rebound from 2016 although the increase is mainly attributable to the Cariboo Gold project (Barkerville Gold Mines Ltd.).

A combination of geologic potential, accessibility, and other infrastructure accounts for the region's productivity. The porphyry copper potential of the area is largely hosted by the Quesnel terrane, mineralized by Triassic-Jurassic intrusions. Gold mineralization is, for the most part, younger (Cretaceous) and found in different orogenic vein and epithermal settings.

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; for a detailed summary of the South Central Region see Britton, 2017). 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 the Monashee complex. These are interpreted as parts of the North American craton (Armstrong et al., 1991), overlain by Neoproterozoic to Paleozoic cover deposited following rifting that formed the western margin of ancestral North America (McDonough and Parrish, 1991; Murphy et al., 1991). To the northwest, the Cariboo terrane (shown as Cassiar in Fig. 1) comprises Neoproterozoic to mid-Paleozoic siliciclastic and carbonate rocks interpreted as distal facies of the North American platform (Struik, 1988a). Also affiliated with ancestral North America, the Kootenay terrane (deep-water basinal strata on Fig. 1) comprise Neoproterozoic to mid-Paleozoic deep-water basin facies equivalent rocks that were 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 extensional deformation (Colpron and Price, 1995). This belt also includes Devonian-Mississippian calc-alkaline to alkaline volcanic rocks and associated granitoid intrusions, found mainly in the Eagle Bay assemblage east and southeast of Clearwater (Schiarrizza and Preto, 1987), which reflect the initiation of east-dipping subduction beneath the North American plate margin. These rocks host polymetallic volcanogenic massive sulphide 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 Late Triassic to Early 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, 2018). The volcanic rocks are mainly augite-phyric shoshonitic basalts, but the western part of the group locally includes a belt of calc-alkaline volcanic rocks with substantial amounts of rhyolite and dacite (Mortimer, 1987; Preto, 1977, 1979). A younger stratigraphic component of Quesnel terrane comprises Lower to Middle Jurassic sedimentary rocks that unconformably overlie western parts of the Nicola Group or (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 or 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, Afton and Mount Polley. A third belt, younger and farther to the east, is defined by several large, Early Jurassic calc-alkaline plutons.

Cache Creek terrane, comprising 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 (Lower 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 (Dohane 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 only a minority 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 Highland** and **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**. **Bralorne**, near Gold Bridge, is moving toward a restart with a permit to mill 100 tpd.

3.1.1. 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 2017 mill throughput averaged more than 38,000 tpd, with feed grade 0.31% Cu and about 78% recovery. Holbek et al. (2015) described the deposit as a structurally complex, alkalic porphyry copper-gold system with mineralization mainly

Table 1. Metal mines, South Central Region.

Mine	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2017 Production (based on Q1-Q3)	Reserves	Resource	Comments
Bonanza Ledge	Barkerville Gold Mines Ltd.	Au; Au-quartz veins; 093H 140	30,000 t (2017 target)	na	M: 248,000 t 8.07 g/t Au I: 436,700 t 6.72 g/t Au Inf: 108,100 t 5.34 g/t Au	Mining began last week of August 2017. Planned 150,000 tpy 6.5 g/t Au diluted for 3.5 years.
Copper Mountain	Copper Mountain Mining Corporation 75%, (Mitsubishi Materials Corporation 25%)	Cu, Au, Ag; alkalic porphyry; 092HSE001	53.6 Mt mined, 10.4 Mt milled Q1-Q3	P: 53 Mt 0.36% Cu, 1.43 g/t Ag, 0.11 g/t Au Pr: 69 Mt 0.30% Cu, 1.15 g/t Ag, 0.11 g/t Au	M+I: 221 Mt 0.33% Cu, 1.3 g/t Ag, 0.10 g/t Au Inf: 228 Mt 0.27% Cu, 1.01 g/t Ag, 0.14 g/t Au	Resources inclusive of reserves. Company projects 36,287 t Cu production 2017.
Gibraltar	Taseko Mines Limited 75%, (Sojitz Corp. 12.5%, Dowa Holdings Co. Ltd. 6.25%, Furukawa Co. Ltd. 6.25%)	Cu, Mo; porphyry; 093B 012	66.2 Mtons mined, 22.0 Mtons milled Q1-Q3	P+Pr: 688 Mt 0.26% Cu, 0.008% Mo	M+I: 1031 million tons 0.25% Cu, 0.008% Mo	Resources inclusive of reserves.
Highland Valley Copper	Teck Resources Limited	Cu, Mo; porphyry; 092ISW012, 045	87.4 Mt mined, 38.525 Mt milled Q1-Q3	P: 334.7 Mt 0.31% Cu, 0.007% Mo Pr: 211.9 Mt 0.26% Cu, 0.010% Mo	M: 517.4 Mt 0.31% Cu, 0.008% Mo I: 953.7 Mt 0.23% Cu, 0.010% Mo Inf: 501.2 Mt 0.24% Cu, 0.008% Mo	Resources exclusive of reserves. 2017 Cu production projected 275,000-290,000 t, Mo 7.5-8.0 Mlb.
Mount Polley	Imperial Metals Corporation	Cu, Au, Ag; alkalic porphyry; 093A 008	4.917 Mt milled Q1-Q3	P+Pr: 73.613 Mt 0.274% Cu, 0.293 g/t Au, 0.562 g/t Ag	M+I: 180.5 Mt 0.26% Cu, 0.251 g/t Au, 0.904 g/t Ag Inf: 14.7 Mt 0.21% Cu, 0.188 g/t Au, 0.904 g/t Ag	Reserves in 5 zones, effective Jan. 1, 2016. Resources (excluding reserves) are as of Aug. 14, 2017 including updated Martel zone. 2017 production targets 20-22 Mlb Cu, 51-55,000 oz Au.
New Afton	New Gold Inc.	Au, Ag, Cu; alkali porphyry; 092INE023	4.596 Mt mined, 4.510 Mt milled Q1-Q3	Pr: 60.336 Mt 0.6 g/t Au, 2.0 g/t Ag, 0.78% Cu	M+I: 56.592 Mt 0.64 g/t Au, 2.1 g/t Ag, 0.76% Cu Inf: 15.219 Mt 0.41 g/t Au, 1.3 g/t Ag, 0.41% Cu	2017 targets 70,000-80,000 oz Au, 85-95 Mlb Cu. Resources exclusive of reserves.

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

in Nicola Group (Triassic) volcanic rocks with subordinate amounts in coeval intrusive rocks. Mineralization shows strong vertical continuity.

A multi-year exploration program resumed at the mine site to extend Pit 2 westward and test mineralization below the pit with 8900 m of drilling. Drilling then moved to the New Ingerbelle (Fig. 2) deposit with a 5000 m program to confirm historical resources and potentially extend mine life by 10 years.



Fig. 2. The Ingerbelle pit at the Copper Mountain mine site.

3.1.2. 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 milled 22 Mtons in the first nine months of 2017 at grades of about 0.3% Cu and 86% recovery. Operations were affected by wildfires in July, preventing personnel from travelling to the mine site and temporarily stopping rail traffic and the ability to ship concentrate.

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 (Late Triassic; see van Straaten et al., 2013 for detailed mine geology) in a fault-bounded section of Nicola Group sedimentary and volcanic rocks (Quesnel terrane; Schiarizza 2014, 2015).

3.1.3. Highland Valley Copper (Teck Resources Limited)

The **Highland Valley Copper** copper-molybdenum mine's (Fig. 1; Table 1) ore comes from three pits (Valley; Lornex; Highmont). Mill throughput capacity is 130,000 tpd. In the first nine months of 2017 it milled 38.525 Mt at a copper grade of 0.22% and recovery of 73.5% as it processed low-grade ore

from the Lornex pit. A project to install an additional ball mill that began in September is projected to increase mill throughput by 5% and copper recovery by 2%.

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 is under review with the Ministry of Energy, Mines and Petroleum Resources. 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 (late Triassic), which has been divided into a number of pre-, syn- and post-mineral phases (see Byrne et al., 2013).

3.1.4. Mount Polley (Imperial Metals Corporation)

The **Mount Polley** copper-gold-silver mine (Fig. 1; Table 1) of Imperial Metals Corporation completed its first year of full operation in 2017 after a breach in its tailings dam in 2014 caused a year of lost production. Normal operations resumed in June 2016. The mine continued through 2017, with the exception of the second half of July when operations were suspended because of a forest fire evacuation order. Ore milled was just over 18,000 tpd in the first nine months of 2017 for 4.9 Mt at 0.207% Cu, 0.337 g/t Au and recoveries of 67% and 71%. Imperial anticipates producing 22-24 million lb Cu and 51-55 thousand oz. Au in 2017, an 8-9% decrease because of the interruption. All 2017 production is coming from open pits, though there are underground resources and reserves.

Late in 2016 the company initiated a 5000 m underground drilling program to test two zones (Martel and Green) from the access ramp to the underground Boundary zone. Exploration continued at the Martel zone into 2017, resulting in a revised resource estimate. The Martel zone lies beneath the Wight pit. In the first half of 2017, Imperial updated the reserve and resource estimates for Mount Polley (Table 1).

The alkalic intrusive complex (Late 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.

3.1.5. 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 2017, ore processed was just over 4.5 Mt at 0.55 g/t Au and 0.82% Cu (80% and 81% recovery). In the first half of 2017, New Gold completed infill drilling of the C zone, a down-plunge extension of the area (B zone) now being mined (Rennie et al., 2015). Satellite targets were also drilled from surface elsewhere in the mine lease area. The New Afton deposits form a high-grade keel beneath the past-producing

Afton open pit mine, an alkalic porphyry in the Iron Mask batholith (Triassic).

3.1.6. Bonanza Ledge (Barkerville Gold Mines Ltd.)

Barkerville restarted the **Bonanza Ledge** mine (Figs. 1, 3; Table 1) as an underground long-hole and cemented-fill operation below the existing pit. They expect to mine about 30,000 t in 2017 and 150,000 tpy thereafter. Initial life of mine is a planned 3.5 years, but there is exploration potential. Ore is trucked to Barkerville's QR mill. 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).



Fig. 3. Portal of the new underground phase of the Bonanza Ledge mine.

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

Avino Silver & Gold Mines Ltd. acquired the **Bralorne** gold mine, near Gold Bridge, 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 necessary to meet permitting requirements. In November, they received an updated permit for a 100 tpd throughput mining operation. Avino anticipates eventually 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. In 2017 they signed a letter of intent with the St'át'imc First Nations on partnerships for the ongoing development of the mine.

Within the new permit boundary are areas of proposed exploration, 8000 m of drilling is scheduled to begin in January, targeting nine veins with existing resources.

3.1.8. Merritt mill (Nicola Mining Inc., 100%)

Nicola operates a 200 tpd custom mill near Merritt and uses tailings storage built for the past-producing Craigmont mine. The mill was originally constructed to process ore from the Treasure Mountain mine, which operated in 2013. The operation was recently upgraded with a gravity jig and concentrating table for processing free gold. In 2017, it underwent modifications and continues to process gold-silver ore from the **Dome Mountain** mine under a contract with Metal Mountain Resources Inc. Nicola also has an agreement with AMA Gold Exploration Ltd. to process a bulk sample from its Dancer property on the Sechelt Peninsula.

3.1.9. QR mill (Barkerville Gold Mines Ltd.)

Barkerville owns the past-producing QR mine. They upgraded the mill and now use the mill and tailings facility to process ore from the Bonanza Ledge mine 110 km away. The tailings facility has capacity for about 900,000 t, adequate for short-term needs.

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 mined 275,000 tons (263,000 t) in 2017. Ashcroft lost 10 days of production because of wildfires (Fig. 4).



Fig. 4. Ashcroft plant of IG Machine and Fiber Ltd. Haze is smoke from wildfires, which affected many exploration projects and mines in the region.

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

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

Mine	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2017 Production (based on Q1-Q3)	Reserves	Resource	Comments
Ashcroft	IG Machine and Fibers Ltd. (IKO Industries Ltd.)	Basalt (roofing granules); 092INW104	250,000 t	na	Approx. 13.3 Mt in 2002	10 days lost to wildfire related causes.
Bromley Creek (Zeotech)	Canadian Zeolite Corp.	Zeolite; Open system zeolites; 092HSE243	na	na	M+I: (as of 2013-06-30): 550,000 t	Producing in 2017.
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, however, alternative markets found for 2017-2018.
Harper Ranch	Lafarge Canada Inc.	Limestone; 092INE001	na	na	na	On care and maintenance as of November 2016. Site clean-up.
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	
Lady King Basalt	Opal Resources Canada Inc.	Basalt columns; na	Intermittent operation	na	na	
Mount Polley Magnetite	Craigmont Industries Ltd.	Magnetite (recovered from tailings); 093A 008	na	na	na	Did not produce in 2017. Plan to resume in 2018.
Nazko	Can Lava Mining Corporation	Lava Rock; Cinder cone; 093B 060	na	na	Historical 45 Mt	Product shipped from quarry in 2017. 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.

Table 2. Continued.

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	9000 t	na	Approx. 800,000 t	Historical resource.

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

because of the Lafarge 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. were placed on care and maintenance. The reason cited was poor demand. The facility will continue to serve as a distribution point for cement produced in Alberta. Apart from limestone, the cement plant used gypsum and anhydrite mined at the **Falkland** quarry and alumina-silica silt obtained from a loess deposit. The Falkland quarry continues to supply gypsum.

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. In 2010, Spectral Gold Corp. (now Opal Resources Canada Inc.) began developing the **Lady King Basalt** deposit selling basalt columns for landscaping.

3.2.5. Klinker (Opal Resources Canada Inc.)

Opal Resources Canada Inc. produces gem quality fire opal from the **Klinker** property. Opal forms fracture and vesicle-fillings in andesitic to basaltic lahars and breccias in the Kamloops Group (Eocene).

3.2.6. Mount Polley (Craigmont Industries Ltd.)

In January 2014, Craigmont Industries Ltd. started producing magnetite from their recovery plant at **Mount Polley** mine. Operations stopped in August 2014, due to the tailings dam breach. Poor markets have delayed its expected restart, now anticipated in 2018. The plant captures magnetite from the mine's tailings stream and produces a dense media used for coal washing.

3.2.7. Pavilion (Graymont Western Canada Inc.)

In 2016, Graymont Western Canada Inc.'s **Pavilion** limestone quarry and lime plant was placed on care and maintenance. The operation produced quicklime, high-calcium limestone fines, screened high-calcium stone products, lime kiln dust, and rip rap. Graymont has a forty year lease with the Ts'kw'aylaxw First Nation to mine on their reserve, and most of the operation's employees were Ts'kw'aylaxw. Graymont is now working toward a closure and reclamation plan acceptable to both parties.

3.2.8. 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.

3.2.9. 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.

3.2.10. Z-1 (ZMM Canada Minerals Corp.)

The ZMM mine (Fig. 5) produced 9000 t of zeolite at Z-1 in 2017. It is currently used as an agricultural feed additive, a growth medium, a filtration medium, and a component of lightweight concrete, and for soil remediation. New applications such as for vacuum insulated panels are being investigated. ZMM explored at other sites in 2017 (see below) and constructed a sample preparation facility in Peachland.

3.2.11. Nazko (CanLava Mining Corporation)

CanLava supplies a lightweight vesicular rock from its Nazko quarry, from a young (Pleistocene-Holocene) cinder cone on the easternmost part of the Anahim volcanic belt. Typical uses include construction aggregate, landscaping, soil enhancement, sports field surfaces, masonry bricks, anti-slip road sand. CanLava shipped from the site in 2017.



Fig. 5. ZMM Canada Minerals Corp.'s Z-1 mine near Cache Creek.

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, except Bralorne, which is preparing to resume mining.

6. Proposed mines

Proposed mines are defined as feasibility-stage projects for which proponents have begun the process of formal socioeconomic and environmental review. For projects that exceed thresholds set by the British Columbia Environmental Assessment Act (or its federal equivalent), reviews are co-ordinated by the BC 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. The MDRC review is informally called the Minister's permit process.

Six projects are in this category: **Ajax**, **Bethlehem**, **Harper Creek**, **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. (KGHM SA) and Abacus Mining and Exploration Corporation. Mineralization is in the Iron Mask batholith, a multi-phase Triassic alkaline intrusive complex. A revised feasibility study released at the start of 2016 modelled Ajax as a 65,000 tpd open pit mine with a projected 18-year life. In December, the project was denied certification by the British Columbia Ministries of Environment and Climate Change Strategy and Energy, Mines and Petroleum Resources. The company has not yet announced a response.

6.2. Bethlehem (Teck Resources Limited)

Teck Resources Limited may reopen the past-producing **Bethlehem** mine, 2 km east of its Highland Valley Copper operations. Over the past few years, Teck defined 100 Mt of new ore at Bethlehem. If approved, the mine would feed its 140,000 tpd mill. A Mine Development Review Committee commenced formal review of the Bethlehem Phase 1 proposal in September 2016.

6.3. Harper Creek (Yellowhead Mining Inc.)

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 Formation (Devono-Mississippian). Yellowhead Mining Inc.'s application for an environmental assessment certificate was accepted in January 2015. However, in October 2015, the company suspended further work on the project and the project remains on hold. The company is evaluating if financing can be secured to complete the review, estimated to cost more than \$4.0 million. 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 feasibility study proposed a 70,000 tpd operation with a mine life of 28 years. Initial capital costs would exceed \$1 billion.

6.4. New Prosperity (Taseko Mines Limited)

The **New Prosperity** (also known as Prosperity or Fish Lake) 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 not to authorize 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. However, the Canadian Environmental Assessment Agency warned Taseko that they would consider the proposed work in violation of federal law and the company did not proceed.

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 (Fig. 1), Imperial Metals Corporation carried out environmental studies and monitoring. 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.

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

Project	Operator (partner)	Commodity; deposit type; MINFILE	Reserves	Resource	Comments
Ajax	KGHM Ajax Mining Inc.	Cu, Au; Alkalic porphyry; 092INE012, 013	(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	Project at application review stage.
Bethlehem	Teck Resources Limited	Cu, Mo; Porphyry; 092ISE001	na	na	Project at application review stage. Resource informally stated as 100 Mt, but without grades.
Harper Creek	Yellowhead Mining Inc.	Cu, Au, Ag; Noranda/Kuroko; 082M 008, 009	(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 grading 0.28% Cu, 0.030 g/t Au, 1.3 g/t Ag	Project at application review stage. Company suspended review in October 2015 for economic reasons.
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 certificate but denied federal approval.
Ruddock Creek	Ruddock Creek Mining Corporation	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 pre-application stage.
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 containing 3.9 Moz Au 6.3 Moz Ag	Project at pre-application stage.

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

6.6. Spanish Mountain (Spanish Mountain Gold Ltd.)

The **Spanish Mountain** project has been in the pre-application phase of environmental assessment since 2011. In April 2017 the company released the results of an updated preliminary economic assessment. The study was based on a 20,000 tpd, 24-year operation focussed on a pit-delineated higher grade core (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 oz/y. A field program

in 2017 was designed to maintain placer claims in the project area. However, the company also acquired a permit for future mineral exploration and archaeological studies.

7. Selected exploration activities and highlights

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

Table 4. Selected exploration projects, South Central Region.

Project	Operator (partner)	Commodity; Deposit type MINFILE	Resource (NI 43-101 compliant unless indicated otherwise)	Comments
Acacia	Eagle Plains Resources Ltd.	Zn, Pb, Ag; Noranda/Kuroko massive sulphide; 082M 075	na	Mapping and soil geochemistry.
Amarillo	Troubadour Resources Inc.	Cu; Porphyry Cu±Mo±Au; 082ENW108	na	Soil geochemistry and IP.
Axe	Evrmin Exploration Canada Corp.	Cu, Au; Alkalic porphyry Cu-Au 092HNE143	I: 39 Mt 0.38% Cu Inf: 32 Mt 0.38% Cu	Core re-logging, re-processing IP. 2006 resource estimate used historical assays that did not include gold.
BC Sugar	Lithium Corporation	Graphite	na	Permitting, sampling, geophysics.
Blue River	Commerce Resources Corp.	Nb, Ta	I: 48.4 Mt 197 ppm Ta ₂ O ₅ , 1610 ppm Nb ₂ O ₅ Inf: 5.4 Mt 191 ppm Ta ₂ O ₅ , 1760 ppm Nb ₂ O ₅	Metallurgical testing.
Bonaparte	Westkam Gold Corp.	Au, Cu; Au-quartz veins; 092P 050	na	Permitting, First Nations relations, site maintenance and preparation for continuation of underground bulk sample.
Brett	Ximen Mining Corp.	Au, Ag; Epithermal Au-Ag; 082LSW110	na	Core logging and analysis (following 2016 drilling), chip/channel sampling.
Cariboo Gold	Barkerville Gold Mines Ltd.	Au; Au-quartz veins; 093H 006, 140, 139, 019	(Cow Mountain at 0.5 g/t Au cut off) I: 35.8 Mt 2.4 g/t Au Inf: 27.5 Mt 2.3 g/t Au	Up to 160,000 m core drilling in 3 areas with recent focus on Island Mountain area. Barkerville Mountain and Cow Mountain also drilled. Regional target generative program in addition. Resource here is 2015 estimate for Cow Mountain. See Table 1 for Bonanza Ledge.
Copper Canyon	Seven Devils Exploration Ltd. (R. Weicker)	Cu, Ag, Au; Porphyry Cu±Mo±Au; 092ISW076	na	Drilling, 2 holes, approx. 500 m.
Fox	Happy Creek Minerals Ltd.	W; W skarn; 093A 259, 260, 258	I: 486,000 t 0.818% WO ₃ Inf: 361,000 t 1.568% WO ₃	Core drilling (11,249 m in 66 holes), geological mapping. Resource estimate precedes 2017 drilling. Combined underground and surface. Indicated is Ridley Creek, Ridley creek and BN zone included in inferred.
Gold Creek	Eureka Resources Inc.	Au, Ag; Au-quartz veins; 093A 127	na	Drilling 331 m in 3 holes.

Table 4. Continued.

Ike	Amarc Resources Ltd. (Hudbay Minerals Inc.)	Cu, Mo; Porphyry Cu±Mo±Au; 092O 025, 067	na	Geological mapping, IP (82 line km), core drilling 2702 m in 9 holes.
Jesse Creek	Wealth Minerals Ltd. (Dawson/Belik)	Cu, Mo, Au; Porphyry Cu±Mo±Au; 092ISE064	na	Core drilling 4479 m in 18 holes, IP, soil and rock geochemistry.
Lac La Hache	Engold Mines Ltd.	Cu, Au, Ag, Fe; Cu skarn; 092P 120, 108, 002	I: 7.6 Mt 0.28% Cu, 0.05 g/t Au, 1.26 g/t Ag, 11.4% magnetite Inf: 15.8 Mt 0.21% Cu, 0.04 g/t Au, 0.93 g/t Ag, 8.32% magnetite	Approximately 20,000 m core drilling, gravity, magnetic and airborne geophysics. 2017 drilling focused on a recent skarn discovery. Resource estimate is for Spout deposit (2012), which is mineralogically similar. Property also hosts a porphyry prospect and hydrothermal Au-Ag-Cu.
Lawless Creek	Tech-X Resources Inc.	Cu, Mo; Porphyry Cu±Mo±Au; 092HNE039, 017, 129	na	IP survey.
Little Gem	Blackstone Minerals Ltd.	Co, Au; Five element veins; 092JNE068, 108	na	Property exam, prospecting, surface and underground rock sampling. Diamond drilling started late in year.
Melba	Essex Minerals Inc. (G. Crooker)	Au, Cu; Epithermal Au-Ag-Cu; 092INE090, 067	na	3D IP (32 km), ground magnetic (37.3 km), soil geochem (600 samples). Prospective for epithermal and porphyry targets.
Miner Mountain	Sego Resources Inc.	Cu, Au; Alkalic porphyry Cu-Au; 092HSE203, 078	na	Core drilling 600 m in 2 holes.
Nesbitt	ZMM Canada Minerals Corp.	Diatomaceous earth; lacustrine diatomite; na	na	Access and site preparation for proposed bulk sample.
New Craigmont	Nicola Mining Inc.	Cu, Au; Cu skarn; 092ISE035	na	Reverse circulation drilling (testing waste dumps), IP survey, Core drilling (approximately 2500 m, 5 holes).
Rabbit North	Tower Resources Ltd.	Cu, Au; Alkalic porphyry Cu-Au	na	Core drilling (approximately 3400 m, 11 holes).
Rateria	Happy Creek Minerals Ltd.	Cu, Mo, Ag; Porphyry Cu±Mo±Au; 092ISE199	na	Core drilling 1764 m in 6 holes.

Table 4. Continued.

Redhill	Troymet Exploration Corp. (J. Shearer)	Cu, Zn, Au, Ag; Noranda/Kuroko massive sulphide; 092INW042, 057	na	Gravity test line.
Shovelnose	Westhaven Ventures Inc.	Au; Epithermal Au-Ag-Cu; 092HNE309, 308	na	Geological mapping, geochemistry, core drilling (3269 m in 7 holes).
SkoonkaCreek	Westhaven Ventures Inc.	Au, Ag; Epithermal Au- Ag-Cu; 092ISW104, 129, 105, 126	na	Geological mapping, geochemistry.
Treasure Mountain North	Ximen Mining Corp. (New Destiny Mining Corp.)	Au, Cu, Zn; Polymetallic veins; 092HSW066 092HSE240	na	Prospecting, soil geochemistry.
Woodjam	Consolidated Woodjam Copper Corp.	Cu, Au; Alkalic porphyry Cu-Au; 093A 078, 269, 206	Southeast zone Inf: 227.5 Mt 0.31% Cu Deerhorn Inf: 32.8 Mt 0.49 g/t Au, 0.22% Cu Takom Inf: 8.3 Mt 0.26 g/t Au, 0.22% Cu	Prospecting, sampling. Discovery of Canyon zone copper showing.
Trans Canada	ZMM Canada Minerals Corp.	Zeolite; Open-system zeolites; 082LNW096	na	Bulk sample started.

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.)

Following bulk sampling of the **Bonaparte** project beginning in 2016, Westkam Gold Corp. acquired permits for surface and underground drilling and obtained authorizations for dewatering that would allow underground development and continued sampling. Up to 10,000 t are permitted. The property was on care and maintenance for most of 2017. In 1994, a 3700 t sample from surface trenches had an average grade of 26.5 g/t. In addition to near-surface gold-bearing quartz veins, chargeability anomalies, alteration assemblages, and proximity to Jurassic intrusive rocks suggest other porphyry targets.

7.1.2. Brett (Ximen Mining Corp.)

Ximen Mining Corp. continued sampling of core drilled at the **Brett** gold project in 2016. Results included 112 g/t Au and 263 g/t Ag over 0.3 m, 7.23 g/t Au over 0.58 m, 6.04 g/t Au over 0.4 m, and 16 g/t Au over 0.39 m. Fieldwork in 2017 also included chip sampling. Epithermal gold mineralization in Eocene volcanic rocks is the target.

7.1.3. Cariboo Gold (Barkerville Gold Mines Ltd.)

Barkerville Gold Mines planned to drill up to 160,000 m in 2017 on their **Cariboo Gold** project and came close by December. Most drilling was in the Island Mountain area, northwest of Cow Mountain and Barkerville Mountain, which were also target areas. All are sites of past producers. Extensive regional exploration identified several targets for drilling in 2018. Environmental baseline and impact assessment studies have been ongoing since 2016.

Most of the drilling in 2017 was near the past-producing

Aurum mine, at the Shaft zone where high-grade gold was intersected. The Valley zone, to the southeast is also a target. Barkerville has identified three vein corridors at the Shaft zone (alpha, beta and gamma) which they are testing with ~25 m-spaced drilling. They describe the corridors as 5 to 35 m wide anastomosing networks with high vein density. Reported high-grade intersections are typically 10s of g/t Au over 5 m or more. Overall, corridors strike north-easterly and have sub-vertical dips. Gold values correlate with vein hosted pyrite and pyritic, silicified haloes.

Past production in the area came from gold-bearing pyrite replacement deposits (Fig. 6a) and gold-sulphide-quartz veins (Fig. 6b). Host rocks are folded and metamorphosed siliciclastic and subordinate volcanic rocks of the Snowshoe Group (Neoproterozoic-Lower Paleozoic).

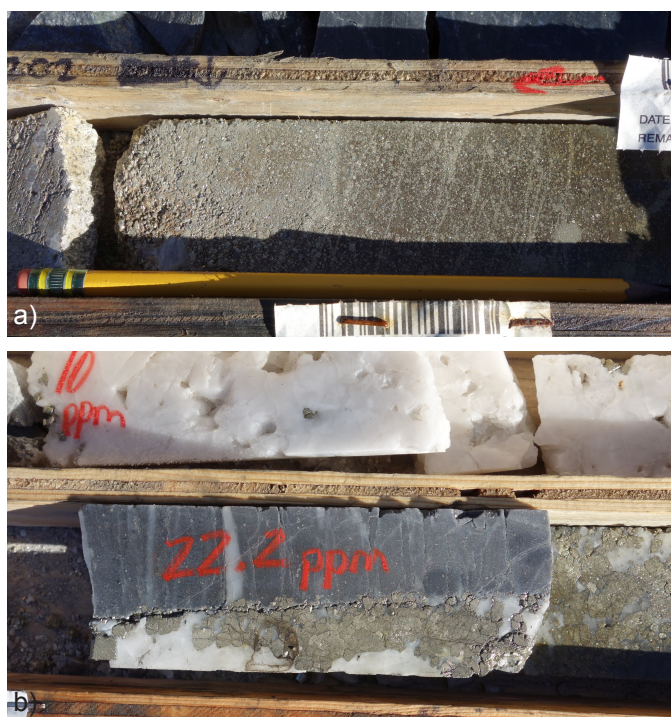


Fig. 6. Barkerville Gold's Cariboo project. **a)** Replacement-style mineralization. **b)** Axial planar vein.

7.1.4. Gold Creek (Eureka Resources Inc.)

Eureka drilled three diamond drill holes at their **Gold Creek** property. Results included 33.20 g/t Au over 1.25 m and 17.95 g/t Au over 1.5 m. Targets are orogenic gold veins in Mesozoic phyllites and greywackes.

7.1.5. Shovelnose (Westhaven Ventures Inc.)

In October, Westhaven began a 3269 m drill program at **Shovelnose**, following 725 m in 2016. Five holes focused on the Tower zone and two on the Alpine zone 0.5 km east. Other 2017 work included a ground magnetic survey, geological mapping, prospecting, soil sampling, and a clay mineralogical study. Shovelnose hosts epithermal style mineralization in Spences Bridge Group volcanic rocks (Cretaceous).

7.1.6. Skoonka Creek (Westhaven Ventures Inc.)

In 2017, Westhaven added **Skoonka Creek** to its properties in the Spences Bridge Group (others are Shovelnose and Prospect Valley), all of which target epithermal gold mineralization. Work at Skoonka Creek included a ground magnetic survey, geological mapping, prospecting, and soil sampling.

7.1.7. Treasure Mountain North (New Destiny Mining Corp.)

Ximen and New Destiny have an option agreement whereby New Destiny may earn 100% interest in the **Treasure Mountain North** property, north of Nicola Mining's Treasure Mountain mine, currently on care and maintenance. Ximen carried out the 2017 exploration on the property, which consisted of rock and soil sampling that included auger sampling in areas of thick overburden. Targets were gold bearing quartz veins.

7.2. Selected porphyry (Cu-Au, Cu-Mo, Mo) projects

More than 15 exploration projects focused on porphyry deposits in 2017. With the exception of Gibraltar, the copper mines all reported exploration programs (see above).

7.2.1. Amarillo (Troubadour Resources Inc.)

Troubadour carried out soil geochemical and induced polarization surveys in 2017 at its **Amarillo** porphyry copper project. The area has seen sporadic activity since the early 1960s, when positive results were reported from sampling a 125 m trench.

7.2.2. Axe (Evrin Resources Corp.)

Evrin Resources Corp. identified target areas at the **Axe** project arising from core re-logging, and reinterpretation of geophysical and geochemical data. A subsidiary of Antofagasta plc entered into an agreement whereby it can acquire a 70% interest during a 10 year period, with exploration proposed for 2018. A resource estimate was updated in 2006 (Table 5). 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. Copper Canyon (Robert Weicker)

Seven Devils Exploration Ltd. drilled two drill holes (approximately 500 m) from two sites and work was filed for assessment. **Copper Canyon** is a Cu-Ag-Au porphyry prospect.

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

Amarc's and Hudbay's 2017 program at **IKE** included 2702 m in nine diamond drill holes, 82 line km of induced polarization, 20 km² of geological mapping and fine-grained talus sampling. The geophysics suggest the mineralized area could be larger than originally thought, leading to plans for wider spaced drilling in 2018. Some regional targets were

explored. Hudbay was a new partner in the project in 2017. Amarc remains the operator. Between 2014 and 2016 they drilled approximately 12,000 m in 21 widely spaced holes. IKE is a Cu-Mo-Ag porphyry prospect.

7.2.5. Jesse Creek (J. Dawson, 50%; G. Belik, 50%)

Wealth Minerals Ltd. drilled 18 holes at the **Jesse Creek** property in 2017 and conducted an IP survey and soil geochemistry. Jesse Creek hosts several skarn and porphyry showings. Wealth, which is primarily a lithium explorer, indicated an intention to terminate their option on the Jesse Creek property in August.

7.2.6. Lawless Creek (Tech-X Resources Inc.)

Tech-X has been exploring its early-stage **Lawless Creek** property for about three years with geological, geochemical, and geophysical surveys. Tech-X is a private company and recent results have not been released, but assessment reports for previous work are available. The principal target is porphyry Cu-Mo (possibly Early Eocene) mineralization (Holtham, 2016).

7.2.7. Melba (Essex Minerals Inc.)

Melba is a target-generation stage project that has been explored intermittently for porphyry and epithermal mineralization types. Essex's 2017 work included 3D induced polarization, magnetic, and soil geochemical surveys. They report a coincident magnetic, resistivity and modest chargeability anomaly as well as copper and gold geochemical responses in soils.

7.2.8. Miner Mountain Miner Mountain (Sego Resources Inc.)

Sego Resources Inc. began an initial 600 m, 2-hole drill program in mid-October at **Miner Mountain**, an alkalic Cu-Au porphyry prospect. The new drilling follows 2012 percussion and core drilling which returned high copper assays and significant gold, including 100.4 m of 0.946% Cu, 0.55 g/t Au and 3.473 g/t Ag.

7.2.9. Rabbit North (Tower Resources Ltd.)

Tower Resources drilled about 3400 m in 11 holes at **Rabbit North** in 2017. They reported significant porphyry style mineralized intersections, including 247 m 0.51% Cu and 0.34 g/t Au, and 88 m of 0.35% Cu and 0.27 g/t Au in the Western Magnetite zone. They reported 133 m of 0.19% Cu and 0.31 g/t Au in the Chrysocolla zone to the south. Rabbit North is an early stage project seeking to delineate alkalic Cu-Au porphyry targets similar to the Ajax and Afton deposits. The Durand Lake stock on the property is alkalic, hosted by Nicola Group rocks and reported to be similar in age to the Iron Mask batholith (Late Triassic-Early Jurassic; Peterson, 2014; Logan, 2013).

7.2.10. Rateria (Happy Creek Minerals Ltd.)

Happy Creek drilled at their **Rateria** project in 2017 (1754 m in 6 holes). Step out holes expanded Zone 2, including 105.5 m of 0.37% Cu and 0.14 g/t Au. Rateria is an early-stage project without a current resource estimate. Rateria is underlain by the Guichon Creek Batholith, which hosts the Highland Valley copper deposits.

7.2.11. Woodjam (Consolidated Woodjam Copper Corp.)

Consolidated Woodjam reported a discovery, the Canyon zone, in the northern part of the **Woodjam** property. A composite grab sample of a malachite-stained quartz feldspar vein in mafic volcanic rocks returned 7.51% Cu, 356 ppm Ag and 589 ppb Au. Further exploration, including a proposed induced polarization survey, was deferred because of forest fires.

7.3. Selected polymetallic base and precious metal projects

Although the region has numerous polymetallic massive sulphide prospects, only a few were active in 2017.

7.3.1. Acacia (Eagle Plains Resources Inc.)

Eagle Plains conducted mapping and soil sampling at the **Acacia** following compilation of historical data. The target is precious metals enriched volcanogenic massive sulphide mineralization in the Eagle Bay assemblage.

7.3.2. Redhill (Troymet Exploration Corp.)

Late in 2015, Troymet Exploration Corp. acquired the **Redhill** property and began exploring VMS copper-zinc and gold targets in suspected Kutcho-Wineglass assemblage equivalent rocks. Historical work had identified three zones (Alpha; Alpha South; Beta) with coincident soil geochemical and geophysical anomalies and sulphide mineralization. In 2017, Troymet's test gravity survey over the Alpha prospect produced anomalies they identify as targets at depth. Their 2016 drilling identified near-surface (5.1 m depth) and deep (206 m downhole) mineralized zones.

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

Skarn projects followed porphyries as the largest projects in 2017, with 3 significant exploration programs, including a major drill program at Lac La Hache, following a discovery early in the year.

7.4.1. Fox (Happy Creek Minerals Ltd.)

At the **Fox** tungsten skarn property, Happy Creek Minerals Ltd. continued to define the extent, grade, and continuity of scheelite mineralization. Mineralization is in flat-lying sedimentary rocks of the Snowshoe Group (Neoproterozoic to Lower Paleozoic) that have been intruded 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. From north to south the zones are: North; BK; Ridley Creek (or “RC”); BN; 708; Nightcrawler-Discovery (or “NC”); and South Grid.

In January 2017, the company updated its resource estimate for the Ridley Creek zone (Desautels and Berndt, 2017). Resources stand at an Indicated 486,000 t grading 0.817 WO₃ and Inferred 361,000 t grading 1.568 WO₃ with a 0.2% WO₃ cut-off for material potentially amenable to open pit extraction and 0.55% for underground resources. The Ridley Creek deposit measures 350 x 175 m, is 5-25 m thick, and comes within 25 m of the surface.

The initial resource for the BN zone, approximately 1 km south of the RC zone, is an Inferred 245,000 t 1.892% WO₃ at a 0.55% cut off. The resource is 20-80 m below surface. Drilling in 2017 focused on the BN zone (4336.3 m in 38 holes). Significant results included 5.05 m 2.980% WO₃ in a step out to the east and 7.81 m 1.36% WO₃ in a step out to the southwest. Overall, the mineralized zone is now approximately 300 x 350 m. As mineralization has a shallow dip, true width is estimated to be 75-95% of reported intervals.

7.4.2. Lac La Hache (Engold Mines Ltd.)

Engold Mines Ltd.’s **Lac La Hache** property covers several prospects including the Aurizon Au-Ag-Cu vein and breccia target, the Spout magnetite-Cu skarn target, Berkey porphyry target, and a recent Fe-Cu-Ag-Au discovery at their G1 gravity target. Their first hole of 2017, targeting a gravity anomaly at G1, intersected skarn-type mineralization with 26.57 m 1.76% Cu, 0.27 g/t Au, 10.29 g/t Ag and 35.8% Fe. This led to an additional ground gravity survey, airborne gravity and magnetic survey (274 line km at 50 m line spacing) and a substantial (~20,000 m) drill program targeting several areas, but largely focused near G1. Drilling continued into December. The company is also producing a resource estimate for the Aurizon zone. The Spout zone has a 2012 resource estimate (Table 4).

7.4.3. New Craigmont (Nicola Mining Inc.)

Nicola Mining Inc. continued to explore the **New Craigmont** (formerly Thule) copper property that surrounds the main pit of the past-producing Craigmont mine, west of Merritt. Work included an induced polarization survey over their Promontory Hill target to confirm an updated three-dimensional model based on a 2005 survey and expand coverage. In October they began core drilling at the Embayment zone and an induced polarization survey on the Titan Queen. A 2016 hole at the Embayment zone intersected 86 m of 1.1% Cu.

The company also used reverse circulation drilling to evaluate Craigmont’s portal stockpiles as potential feed for Teck’s mill at Highland Valley Copper because the former mine’s cut-off grade was as high as 1.2% copper.

7.5. Selected specialty metals and industrial mineral exploration

Location near transportation corridors and population centres mean low unit value products such as many industrial minerals

are potentially viable targets in the region. Varied geology leads to some relatively unusual prospects such as cobalt-bearing polymetallic veins and carbonatites with Ta, Nb and rare earth potential.

7.5.1. BC Sugar (Lithium Corporation)

Lithium Corporation received a permit for trenching at their **BC Sugar** graphite property. The work was planned for 2017 but deferred due to forest fires. They collected a small bulk sample late in the year, and submitted it for metallurgical study.

7.5.2. Blue River (Commerce Resources Corp.)

Commerce signed a memorandum of understanding for delivery of a 1 t sample from their **Blue River** project’s Upper Fir deposit to an Estonian metallurgist to test his proprietary process for separation of niobium and tantalum.

7.5.3. 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. In the course of a property examination, they discovered the Roxey showing west of Little Gem, which returned 24 g/t Au and 1.9% Cu in surface chip samples. Values from surface and underground samples at Little Gem and Jewel were consistent with high-grade samples reported historically. Surface diamond drilling commenced late in the year. The company increased its land position by staking. The Little Gem hosts vein-type cobalt-gold mineralization with anomalous Ag, Ni, Bi, U and As, an unusual occurrence in British Columbia.

7.5.4. Nesbitt (ZMM Minerals Canada Corp.)

ZMM is planning a bulk sample at the **Nesbitt** diatomaceous earth prospect. They began access and site preparation work late in the year.

7.5.5. Trans Canada (ZMM Minerals Canada Corp.)

ZMM is collecting a bulk sample at the **Trans Canada** property. They describe the target material as a suite of iron bearing zeolites. Currently, zeolites are widely used for water filtration and soil amelioration and as catalysts, biological growth media, pozzolans in cement, and additives to detergent; other uses are being explored.

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 (2018) continued to develop a comprehensive stratigraphic framework for Nicola Group rocks. Mao et al. (2017) used the Nechako Plateau as a study area for investigating the use of detrital apatite as an indicator mineral for mineral deposits. Sacco et al. (2017a-f) published basal till potential maps for the northwestern part of the region. Buckingham et al. (2017) published a compilation of gravity data from the Interior

Plateau, and Angen et al. (2017a, b) produced complementary bedrock geology maps, correlated with magnetic data. Hart and Goldfarb (2017) concluded that gold mineralization in the Bridge River camp is Late Cretaceous.

9. Outlook for 2018

The region's largest exploration projects, Cariboo Gold and Lac La Hache, should continue into 2018, as should Rabbit North. Amarc has indicated an intention to continue with widely spaced drilling at IKE, and Avino's program at Bralorne is scheduled to begin in January. A number of exploration projects were either cut short or deferred due to forest fires; some of these may proceed in 2018.

Acknowledgments

Thanks to those in industry who provided access to their properties and information about their work. Sarah Furney drafted Figure 1. Thanks also to retired Regional Geologist, Jim Britton, for an introductory tour and background information on this important mining region.

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