BRITISH COLUMBIA | Ministry of Energy and Mines

Exploration in the Kootenay-Boundary Region, 2014

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1.0. INTRODUCTION

The Kootenay-Boundary Region offers a variety of mining and exploration opportunities, and is accessible by well-developed infrastructure. Five operating coal mines produce the bulk of Canada's coal exports. The historic, past-producing lead-zinc-silver Sullivan Mine is in the region, and exploration for base metals and precious metals continues to be a focus. Several mines produce industrial minerals including silica, magnesite, gypsum, and graphite.

In 2014, total exploration spending and drilling increased relative to 2013, with about $50.4 million spent on exploration (Fig. 1). Exploration drilling (approximately 125,000 m; Fig. 2) increased for metals projects relative to last year, whereas coal exploration drilling was scaled back. With softer coal prices, drill programs in the coal mines were cut, and spending was focused on mine development and mine evaluation projects (Fig. 3), mainly on Environmental Assessment requirements for mine expansions. Coal production increased from 25.6 Mt in 2013, and is expected to be approximately 27 Mt for 2014 (Table 1).

Fig 1. Exploration Expenditures

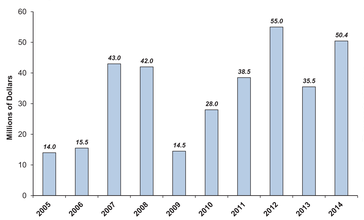


Fig 2. Drilling Meters

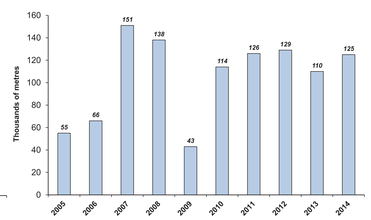
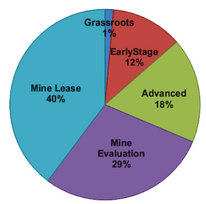


Fig 3. Project Stages



2.0. GEOLOGICAL OVERVIEW

The Kootenay-Boundary Region contains autochthonous and parautochthonous 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 back-arc extension that split the western flank of ancestral North America to form the Slide Mountain ocean; and Quesnellia and its basement (Okanagan subterrane) which, entirely exotic to North America, accreted to the continental margin in the middle Jurassic (Nelson et al., 2013; Fig. 4).

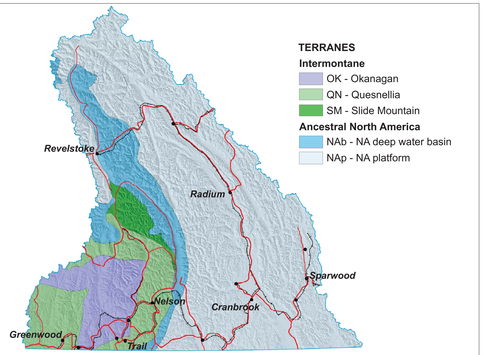


Fig 4. Terrane Map (Modified from Nelson et al., 2013)

3.0 COAL

The Kootenay-Boundary Region is home to five operating mines in the Elk Valley. These mines, operated by Teck Coal Limited, produce approximately 70% of Canada's total annual coal exports. The main product is metallurgical coal (85%), with some thermal and pulverized coal injection (PCI) coal (15% combined). Coal mining in southeastern British Columbia dates back to the 1800s, with reports of coal discoveries in the Elk Valley around 1845. The first underground mine, at Coal Creek, opened in 1897 and operated until 1958. In the early 1900s, and into the 1960s, several other underground mines operated intermittently, and produced industrial steam coals and coke for the smelting industry.

The main coal deposits in southeastern British Columbia are in the Rocky Mountain Fold and Thrust Belt, and extend along strike for 175 km, following the northwest-southeast trend of the Rocky Mountain Front Ranges (Figs. 5a, 5b). The coal seams are in sedimentary rocks of the Kootenay Group where structurally thickened and exposed sections allow for open-pit mining. Mineable coal seams are in the Mist Mountain Formation, and are considered to have been deposited in a coastal plain depositional system, in which delta and interdelta deposits in the lower part of the section grade upward to fluvial deposits.

2014 Highlights:

- continued exploration and expansion plans underway at all 5 operating mines: ***Line Creek Phase II, Line Creek Burnt Ridge Extension, Fording Swift, Greenhills Cougar Pit Extension, Elkview Baldy Ridge Extension*** (Table 1)
- major exploration projects at various stages in the area: ***Coal Mountain Phase II (Marten-Wheeler), Coal Creek, Michel Creek, Crown Mountain, Bingay Creek*** (Table 2)
- approval of the **Elk Valley Watershed Management Plan**: developed to address increased concentrations of mining-related substances from entering the watershed
- total clean coal production from the Elk Valley in 2014 was approximately 27 Mt, and increase from 2013 production volumes of 25.3 Mt.
- the 5 operating coal mines directly employ over 4,500 people full-time

Table 1. Major mines (2014)

Mine	Operator; and Partners	Forecast Production (based on Q1-Q3)	Proven + Probable Reserves of Clean Coal (as of December 31, 2013)	Major Mine Expansion Projects
Fording River	Teck Coal Ltd. (100%)	8.97 Mt	628.6 Mt HCC; 4.6 Mt Thermal	Swift: pre-application stage of EA
Greenhills	Teck Coal Ltd. (80%); POSCAN (20%)	5.15 Mt	53.3 Mt HCC; 3.04 Mt PCI; 0.96 Mt Thermal	Cougar Pit Extension (CPX) preparing for pre-application of EA (2015)
Line Creek	Teck Coal Ltd. (100%)	3.40 Mt	55.7 Mt HCC; 3.4 Mt PCI; 8.3 Mt Thermal	Burnt Ridge Extension (BRX): pre-application of EA (2014)
Elkview	Teck Coal Ltd. (95%); Nippon Steel & Sumimoto Metal Corp. (2.5%), POSCO (2.5%)	5.45 Mt	176.3 Mt HCC	Baldy Ridge Extension (BRE): pre-application of EA(2014)
Coal Mountain	Teck Coal Ltd. (100%)	2.54 Mt	9.5 Mt PCI; 0.7 Mt Thermal	Possible pit extension of 6-pit

Table 2. Exploration and major projects (2014)

Mine	Operator	Resource (Measured & Indicated)	Significant results
Crown Mountain	NWP Coal Canada Ltd (Jameson Resources Ltd)	HCC + PCI: 68.9 Mt Measured + 6.0 Mt Indicated (2014)	Pre-application of EA (2014); 16-year mine life; 1.7 Mt/yr
Coal Mountain Phase II (Marten Wheeler)	Teck Coal Ltd	PCI + Thermal: 117.09 Mt Measured + 100.97 Mt Indicated (2014)	Pre-application of EA (2014); total of 76.5 Mt; 34-year mine life; 2.25 Mt/yr
Coal Creek	CrowsNest Pass Coal Mining Ltd	HCC + PCI: 616 Mt in the upper seams (2014)	Optimization of the PFS; geological modeling
Michel Creek	CanAus Coal Ltd.	120 – 140 Mt estimated	Coal quality results; geological model; 20 coal seams: cumulative thickness of 70m
Bingay Main	Centremount Coal Ltd.	42.43 Mt Measured + 52.9 Mt Indicated (2012)	Pre-application of EA (2012); 20-year mine life; 2 Mt/yr; total of 39 Mt HCC

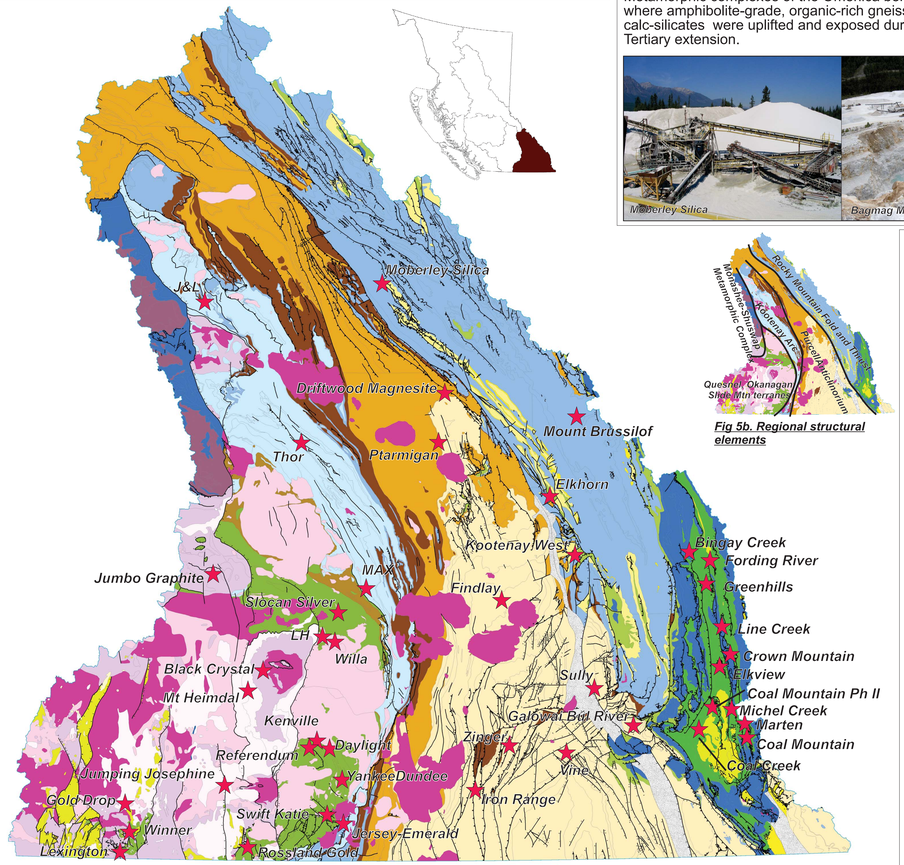


Fig 5a. Bedrock map of the Kootenay-Boundary Region, and selected exploration and mining projects (2014)

TECTONIC ASSEMBLAGES

Quaternary
- Undivided Quaternary

Palecene
- Transitional volcanic rocks

Cretaceous
- Deltaic siliciclastic rocks (Blairmore Group)

Triassic - Jurassic
- Marine to fluvial-deltaic siliciclastic rocks (Spray River and Kootenay Group)

Triassic - Jurassic
- Island arc volcanic to siliciclastic rocks (Nicola, Slocan, Ymir and Rossland Groups)

Devonian - Triassic
- Slide Mountain Terrane - oceanic basin volcanic and siliciclastic rocks

Devonian - Carboniferous
- Carbonate rocks - limestones and dolomites

Cambrian - Devonian
- Passive margin limestones, dolomites, and evaporites

Ordovician
- Passive margin siliciclastic and carbonate rocks

Neoproterozoic - Paleozoic
- Kootenay Terrane - deep water siliciclastic and volcanic rocks (Lardeau Group, Laib, Badshot)

Neoproterozoic - Lower Cambrian
- Rift and margin sediments (Gog and Hamill Groups)

Neoproterozoic
- Windermere Supergroup: continental margin fine to coarse siliciclastics, and carbonates

Mesoproterozoic
- Purcell Supergroup: rift fill and cover siliciclastics and carbonate rocks

PLUTONIC ROCKS

Tertiary
- Stocks and Plutons: diorite to granite (Ladybird, Airy, Coryell, and undivided)

Middle to Late Cretaceous
- Stocks and Plutons: quartz-diorite-tonalite to granite (Bayonne, and undivided)

Middle Jurassic - Early Cretaceous
- Stocks and Plutons: diorite to granite (Nelson, Kuskanax, Rossland, and undivided)

METAMORPHIC ROCKS

Neoroterozoic - Paleozoic
- Undivided pargneiss, calc-silicates (Eagle Bay, Valhalla, Kettle River Complexes)

Paleoproterozoic
- Craton-related paragneiss, calc-silicates and metasediments

Paleoproterozoic
- Monashee Complex: augen gneiss, paragneiss

4.0. INDUSTRIAL MINERALS

The Kootenay-Boundary Region continues to be an important source of industrial minerals such as gypsum, magnesite, silica sand, gabbro and basalt as compoments for mineral wool, dolomite, limestone, graphite, tufa, flagstone, railroad ballast, rip rap, smelter slag, and aggregate (Table 3).

The largest mines are on the western edge of the Rocky Mountain Fold and Thrust Belt, in Paleozoic carbonate and siliciclastic successions that were deposited on the passive margin of ancestral North America. Uplifting along thrust faults has exposed these deposits, enabling them to be easily mined (Figs. 5a, 5b).

Active exploration for graphite is also ongoing in the Metamorphic complexes of the Omenica belt (Fig. 5a), where amphibolite-grade, organic-rich gneisses and calc-silicates were uplifted and exposed during the Tertiary extension.

Table 3. Selected industrial mineral mines and major projects (2014)

Mine	Operator	Commodity; deposit type	Production	Reserves / Resources	Near-mine exploration and project highlights
Mount Brussilof	Baymag Inc	Magnesite	180 Kt (MgO and MgOH)	Reserves: 50 mt Proven	-
Moberley Silica	Heemskirk Canada Ltd	Silica; industrial use silica and frac sand	-	Reserves: Proven 8.9 Mt @ 64% frac sand + Probable 4.6 Mt @ 64% frac sand; OR 12.8 Mt Proven + 0.7 Mt Probable industrial silica (June 2014)	$26M capital cost for plant construction and upgrades to existing facility; 300,000 t/y; Construction started on frac sand processing plant (2014)
Horse Creek Silica	HiTest Sand Inc	Silica	-	Not reported	Aggregate and industrial use products
Elkhorn (Elkhorn Quarry West Extension)	CertainTeed Gypsum Canada Inc	Gypsum	400,000 tonnes anually	Not reported	7 years mine-life remaining
Kootenay West	CertainTeed Gypsum Canada Inc	Gypsum	North and South Quarries: Total 15 Mt (83-85%)	Estimated 15 Mt mineable	Pre-application of EA (2014); 400,000 t/yr; 38-year mine life
Winner; Friday Quarry	Roxul Inc.	Gabbro/Basalt (mineral wool)	Quarrying to supply feed stock for mineral wool plant	N/A	Production; stockpiling; environmental; bulk sample
4-J	Georgia Pacific	Gypsum	N/A	N/A	Care and Maintenance
Driftwood Magnesite	MGX Minerals Inc	Magnesite	N/A	N/A	Drilling; metallurgical testwork; lease application
Marten Phosphate	Fertoz Ltd	Phosphate; upwelling	N/A	N/A	Drilling; trenching; bulk sample (2,000t); XRF of stockpiles: 24 – 27% P_2O_5
Zim Frac Sand	92 Resources Corp	Silica; industrial use	N/A	N/A	Sampling; metallurgical testing: 98.3-99.0% SiO_2
Black Crystal	Eagle Graphite Corp	Graphite	N/A	Regolith: Measured + Indicated: 0.648 Mt @ 1.83% fixed carbon; Calc-silicate: Indicated: 4.765 Mt @ 1.21% fixed carbon	Surface work; mine design; permitting
Mt Heimdal	Lithium Corp	Graphite	N/A	N/A	Sampling; up to 3.7% graphite
Jumbo Graphite	Noram Ventures Inc	Graphite	N/A	N/A	Results; 86.7m grading 1.81% C; 40.9m grading 2.49% C

Fig 5b. Regional structural elements

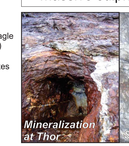
5.0. METALS

Exploration continued in the Purcell Anticlinorium, the Kootenay Arc, Quesnellia, and the Okanagan sub-terrane (Table 4, Figs. 4, 5a, 5b).

- The Purcell Anticlinorium is a broad, north-plunging structure underlain by Proterozoic rift successions of Ancestral North America (Figs. 5a, 5b). Mineralization types include: sedimentary exhalative (SEDEX) deposits (bedded sulphide, feeder pipe, and vein); massive sulphide replacement deposits (Irish-type, Mississippi Valley type, and manto); Mesoproterozoic intrusion and fault-related Ag-Pb-Zn and Cu-Ag veins; Mesozoic shear and vein gold, and associated placer deposits.
- The Kootenay Arc is a 400 kilometre-long curved belt that includes Paleozoic to Mesozoic rocks of the Kootenay Terrane and parts of the North American platform (Figs. 5a, 5b). Deposits include stratiform, laminated, to massive sulphides; replacement-style Irish-type, Besshi-type; Cu-Zn-rich VMS, and boron-enriched exhalites (Nelson, et al, 2013); and Mesozoic precious-metal, and Cu-Au skarn mineralization.
- The Quesnel, Slide Mountain and Okanagan exotic terranes accreted to the western margin of North America during the Mesozoic. Mineralization occurs as Ag-Pb-Zn±Au,Cu polymetallic vein; shear-hosted, stockwork and breccia deposits; replacement-type base metals; Cu-Au-Ag and base metal skarns; porphyry Cu-Mo; alkalic porphyry Cu-Au-Ag; Au-Ag epithermal vein; Zn-Pb bearing mesothermal quartz veins; precious metal, and base metal massive sulphides.

Table 4. Selected metal exploration projects (2014)

Property	Operator	Commodity; deposit type	Work program
Bul River (underground)	Purcell Basin Minerals Inc	Cu-Ag-Au+/-Pb-Zn; Cu-Ag vein	Permitting; baseline; mine plan and mine design; ARD/ML
Findlay	MMG Liminted	Pb-Zn-Ag+/-Cu; SEDEX, polymetallic vein	Drilling; mapping; geophysics; modelling
Sully	Santa Fe Metals Corp	Gravity anomaly	Drilling; mapping; geophysical and geological modeling
Vine	PJX Resources Inc	Pb-Zn-Ag+/-Au; polymetallic vein, SEDEX	Drilling; gravity survey; geophysical/geological model
Iron Range	Santa Fe Metals Corp	Pb-Zn-Ag+/-Au-Cu; veins, breccia, SEDEX, IOCG	Geological modeling; sampling
Zinger	PJX Resources Inc	Au+/-Pb-Zn-Ag; vein	Mapping; soil sampling
Ptarmigan	Silver Mountain Mines Inc	Ag-Pb-Zn+/-Au-Cu; manto, polymetallic vein	Drilling
Iron Range	Santa Fe Metals Corp	Ag-Pb-Zn+/-Au-Cu; vein, SEDEX, IOCG	Data compilation; mapping
J & L (underground)	Huakan International Inc	Ag-Pb-Zn+/-Au; SEDEX, carbonate-hosted, vein	Engineering and baseline studies; metallurgical testwork
Thor	Taranis Resources Inc	Ag-Pb-Zn+/-Au; vein, stratiform manto	Surface drilling; trenching; panel sampling; metallurgical
Teddy Glacier / Spider Mine	Jazz Resources Inc	Ag-Pb-Zn+/-Au; polymetallic veins	Metallurgical testwork (flotation); ARD
Jersey-Emerald	Margaux Resources Inc	Pb-Zn-Ag+/-W-Au-Mo-Bi; stratiform, skarn	Drilling; mapping; sampling; geological modeling
Slocan Silver (Silvana)	Klondike Silver Corp	Ag-Pb-Zn+/-Au; polymetallic vein	Engineering: underground structure/tailings/dam safety
Willa	Discovery Ventures Inc	Ag-Pb-Zn +/-Au-Cu-Mo; subvolcanic breccia, polymetallic veins, porphyry Mo, Au-skarn	PEA; geological modelling; mine design; MAX mill upgrades; core re-sampling; Lidar survey; permitting
LH	Magnum Goldcorp Inc	Cu-Ag-Au; subvolcanic, Au-veins	Drilling; SP/IP/magnetometer survey
Daylight	Sultan Minerals Inc	Ag-Pb-Zn+/-Au-Cu; polymetallic vein, porphyry	Mapping; sampling
Kennville	0995237 B.C. Ltd (privately owned)	Au-Cu-Pb-Zn-Ag-W; Au-vein, Cu-Au alkali porphyry, intrusion-related Au	Permitting; surface work; mine planning; public consultation; mapping
Yankee-Dundee	Armex Mining Corp	Ag-Pb-Zn+/-Au; veins	Permitting; mapping
Swift Katie	Riverside Resources Inc	Cu-Au-Ag+/-Mo; porphyry	Drilling; soil geochem; mapping
Jumping Josephine	Orex Minerals Inc	Au-Ag; Au-quartz veins	Drillling; mapping; trenching
Rossland Gold	West High Yield (W.H.Y) Resources Ltd	Au-Ag-Pb-Zn, Mg; veins, ultramafic-hosted	Mapping; sampling
Gold Drop	Ximen Mining Corp	Au-Ag-Pb-Zn+/-Cu; vein, alkalic intrusion - Au	Trenching; mapping; sampling
Lexington (Greenwood)	Huakan International Mining Inc	Au-Cu-Ag+/-Pb,Zn; porphyry, epithermal, vein	Care and maintenance; environmental



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