



MINISTRY OF ENERGY, MINES AND NATURAL GAS

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# Regional Geologist Summaries

## EXPLORATION AND MINING IN BRITISH COLUMBIA 2012



New 5 Year  
Index Included







Ministry of  
Energy, Mines  
and Natural Gas

**Regional Geologist Summaries**  
**EXPLORATION AND MINING**  
**in British Columbia 2012**

**Ministry of Energy, Mines and Natural Gas**  
Mines and Mineral Resources Division

**Front Cover:**

The field camp near Stewart for the Granduc copper project of Castle Resources Inc. Drilling up to late 2012 outlined a resource of 11.32 Mt of 1.39% copper (measured and indicated) at this former producer.

**Back Cover:**

View looking north of Burnt Ridge South pit highwall at Line Creek Operations, an east Kootenay coal mine operated by Teck Coal Limited.

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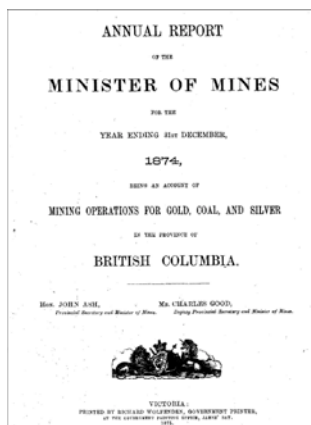
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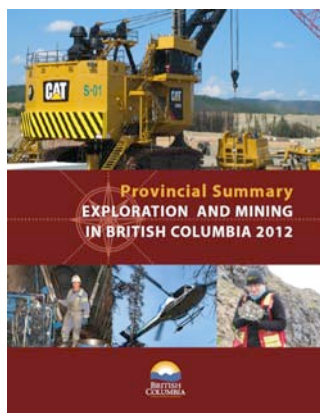
# FOREWORD

## INTRODUCTION

*Regional Geologist Summaries, Exploration and Mining in British Columbia 2012* represents the latest annual documentation of the activities of the province's exploration and mining industry. The record goes back to 1874 when the *Annual Report of the Minister of Mines* (Figure 1) first went to print and has evolved through various formats over the years. The volume provides a region-by-region perspective with an in-depth look at significant projects in British



**Figure 1.** The duty of the collection of information on the province's mining industry goes back to 1874 when the *Annual Report of the Minister of Mines* first went to print.



**Figure 2.** *Provincial Summary, Exploration and Mining in British Columbia 2012* is a companion volume to this publication and provides a more generalized overview of the Province's Mining and Exploration industry.

Columbia. Readers who wish to acquire a general picture of the mining and exploration industry in British Columbia may find the *Provincial Summary, Exploration and Mining in British Columbia 2012* (Figure 2) to be a useful publication. A name change to both documents this year was undertaken to clarify the relationship between them. A trial index of projects contained in the regional summary papers has been prepared. It looks back five years and it intended to add value to the documents by making property searches easier.

*Provincial Summary, British Columbia Mines & Mineral Exploration Review 2012* is a companion volume to this publication and provides a more generalized overview of the Province's Mining and Exploration industry. The province's exploration sector for coal, metals and industrial minerals is large and by necessity the reviews and summaries contained in this volume tend to be focused on the larger and/or more advanced projects. To learn about other projects, readers are encouraged to contact the appropriate regional geologist. Contact information is given below.

Readers are also encouraged to use this publication in concert with the online geological databases accessible through the Ministry of Energy, Mines and Natural Gas Internet site (<http://www.empr.gov.bc.ca/Mining/Pages/default.aspx>). The Ministry's well known MapPlace is a gateway to mineral and coal inventories (MINFILE; COALFILE); assessment reports; tenure; geology; geochemistry; and geophysics.

### ***BC's Regional Geologists and the Geological Survey***

The Regional Geologists were reassigned to the Ministry of Energy, Mines and Natural Gas this year and welcomed back to the home ministry of the Geological Survey. They are located in Vancouver (Bruce Northcote), Smithers (Jeff Kyba), Kamloops (Jim Britton), Prince George (Paul Jago) and Cranbrook (Dave Grieve) (Figure 3). In early 2013, Dave Grieve will retire after an exemplary career with government where his expertise as a coal geologist benefited industry and government tremendously (Figure 4).

Their role will continue to include providing geological and mineral industry expertise and promotion of mineral exploration and development in the province. As regional subject experts they also support various functions of the natural resource sector agencies in meeting the broader goals of government.

Regional geologists' roles and responsibilities include:

- fostering sustainable exploration, development and use of the province's mineral and coal resources;





**Figure 3.** The locations of the various regions referred to in this publication and the locations of many of the cities and towns in the province.



**Figure 4.** Regional Geologist for the Kootenay Region, Dave Grieve, is retiring in early 2013 and set to join the ranks of Emeritus Regional Geologists. Congratulations Dave!

- providing clients with up-to-date technical information and professional advice about known and potential mineral and coal deposits;
- acting a regional contacts for the Geological Survey and pursuing joint project work
- providing geological and mineral resource information to project review or land-use decision-making processes;
- monitoring the status of the mining industry and the development of infrastructure required for mineral resource development;
- working on field projects and surveys, compilations, promotional brochures and deposit models; and
- contributing information to maintain and update geosciences databases (e.g. MINFILE).

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## **Methodology**

Compilation of both *Exploration and Mining in British Columbia* documents presents certain challenges. Deadlines demand manuscript submission before all information from programs carried out later in the year is available, and before some programs are even complete. It is also difficult to garner information on all programs that have occurred. In particular, critical grassroots exploration that leads to many new discoveries may be difficult to track because it typically occurs below *Mines Act* permit thresholds.

Regional geologists maintain contact with their industry peers throughout the year, and ideally are able to visit them at 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. Late in the year informal surveys are conducted to gather as much of the statistical information as possible, but in some instances the authors use their professional judgement to provide reasonable estimates.

Exploration expenditures are broken down by category: grassroots exploration, early-stage exploration, advanced exploration, mine evaluation, and mine lease exploration. Grassroots exploration commonly does not require permitting and the activities and expenditures assigned to this category are less likely to be reported. Early-stage exploration involves focused activities often based on a deposit model. It may include geophysics, geochemistry, trenching and drilling. Advanced-stage exploration is concerned with resource definition emphasizing drilling and bulk sampling, but may include baseline environmental studies, economic pre-feasibility work and exploration of secondary targets. Mine evaluation begins with the firm commitment to develop a resource, and usually coincides with a pending application to government to open a mine; it tends to concentrate on the environmental, social, engineering and financial assessments of a project. Mine lease exploration represents work on a mining property beyond known reserves; it may have characteristics of early-stage or advanced exploration.

Since the exploration expenditures include some estimates, final dollar figures for each region are rounded to the nearest whole million.

## **ACKNOWLEDGMENTS**

The cooperation of the industry in providing information and access to project sites is always welcomed and sincerely appreciated. John DeGrace and Paul Wojdak, emeritus Regional Geologists, have provided editorial commentary and oversight for their former regions. Robin Chu and Betty Chow in Vancouver have provided valuable support in sections throughout the publication. The keen eyes of Lawrence Aspler have improved the document on many fronts. Compilation and layout of the volume was completed by George Owsicki and Garry Payie of Total Earth Science Services.



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## INDEX (2007-2011 Exploration and Mining in British Columbia)





# EXPLORATION AND MINING IN THE OMINECA REGION, BRITISH COLUMBIA

By C. Paul Jago, M.Sc., GIT,  
Regional Geologist, Prince George

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## 1.1 SUMMARY AND TRENDS

Mineral exploration in north-central BC had a varied focus in 2012. Exploration included: epithermal gold-silver in the Nechako Plateau and Toodoggone Region; nickel alloy in the Cache Creek Terrane; copper-gold porphyry in the Quesnel Terrane and Toodoggone; and zinc-lead-silver and niobium-enriched carbonatite along the Ancestral North American margin. Exploration was particularly intense in the Nechako Plateau and Toodoggone Region. Juniors companies with copper-gold projects in the Quesnel Terrane reported financing challenges in an adverse market, and several projects were put on hold in favour of flagship projects elsewhere. Some commenced programs later in the year. Molybdenum-copper projects in the Nechako Plateau saw limited work. Despite these challenges, year-on-year total exploration expenditure for the region more than doubled in 2012 (2.29 times) to \$163.5 million with substantial investment coming from advanced stage projects. Drilling also increased by a factor of 1.86 to 301 672 m.

Exploration highlights in alphabetical order of project included

- completion of Preliminary Economic Assessment (PEA) studies for **Blackwater** (New Gold Inc), and **Angus** (Stikine Energy Corp);
- initial or updated resource estimates for **3Ts** (Independence Gold Corp), **Akie** (Canada Zinc Metals Corp), **Aley** (Taseko Mines Ltd), **Decar** (First Point Minerals Corp under option to Cliffs Natural Resources Inc), **Lorraine** (Lorraine Copper Corp under option to Teck), and **MAC** (Stratton Resources Inc);
- and drilling programs, here listed by targeted deposit-type(s):

*Porphyry (copper-gold):* **Choo** (Serengeti Resources Inc under option to Freeport-McMoran of Canada Ltd), **Kwanika** (Serengeti Resources Inc), **Mex** (Cascadero Copper Corp under option to Gold Fields), **Tagai** (Strategic Metals Ltd), **Tchentlo** (Serengeti Resources Inc under option to Freeport-McMoran of Canada Ltd);

*Low-sulfidation epithermal or vein (gold-silver):* **3Ts** (Independence Gold Corp), **Big Bear** (Parlane Resource Corp), **Blackwater** (New Gold Inc), **Blackwater East/Northeast** (RJK Explorations Ltd), **Capoose** (New Gold Inc), **Copley** (Northern Vertex Mining Corp in joint venture with Kootenay Silver Inc), **JD** (Tower Resources Ltd), **Ruby** (Brocade Metals Corp), **Trout** (Venerable Ventures Ltd), **Zakco** (Strategic Metals Ltd);

*Porphyry and/or Low-sulfidation epithermal:* **Bandit** (Stina Resources Ltd under option to Copper Creek Gold Corp), **Hubble** (Amarc Resources Ltd), **Key** (Troymet Exploration Corp);

*Nickel-alloy (awaruite):* **Decar** (First Point Minerals Corp under option to Cliffs Natural Resources Inc), **Klow** (First Point Minerals Corp);

*Carbonatite (niobium):* **Aley** (Taseko Mines Ltd);

*Sedimentary Coal (anthracite):* **Groundhog** (Atrum Coal);

*Industrial Mineral (magnesium):* **Hoof** (Porpoise Bay Minerals Ltd).

### 1.1.1 Summary Figures and Tables

Figure 1.1 shows locations of mines and major exploration projects discussed in this report. Figure 1.2 provides a year-on-year comparison of exploration expenditures for the last three years. Figure 1.3 sets out the approximate allocation of 2012 expenditures among Grassroots, Early stage, Advanced stage, and Mine Evaluation exploration in the region. Figure 1.4 compares annual drilling statistics. Table 1.1 gives mine production tonnage in 2011 and reserves. Table 1.2 lists details of the major exploration programs in 2012. Placer exploration and mining, although a significant traditional and ongoing activity in the region, are not included in this report.



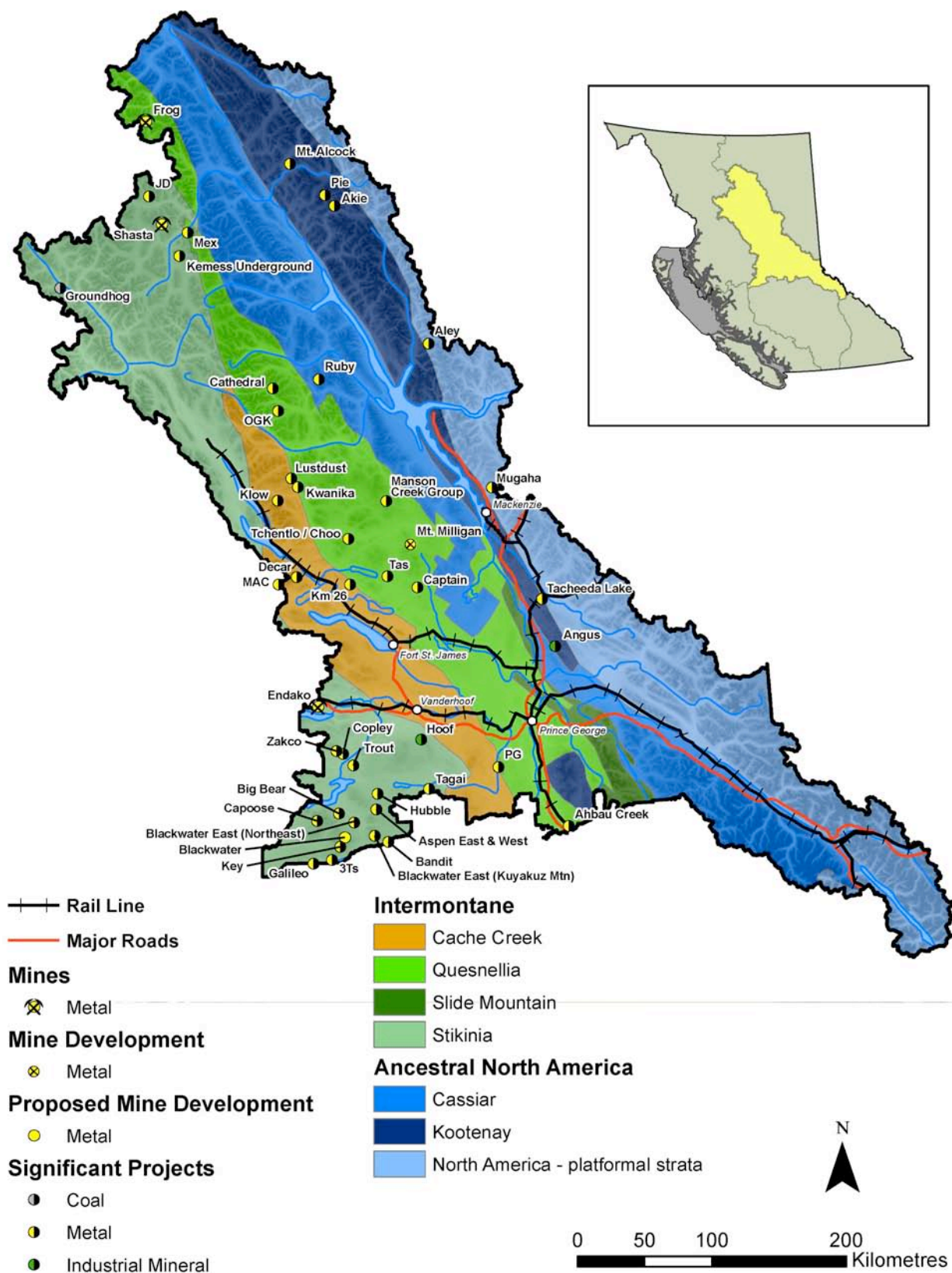
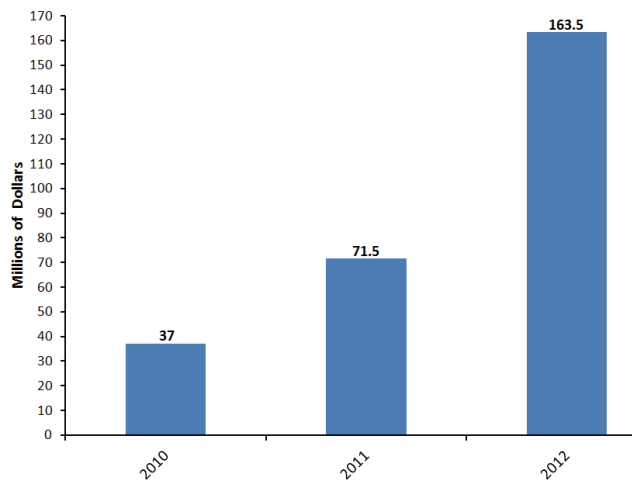
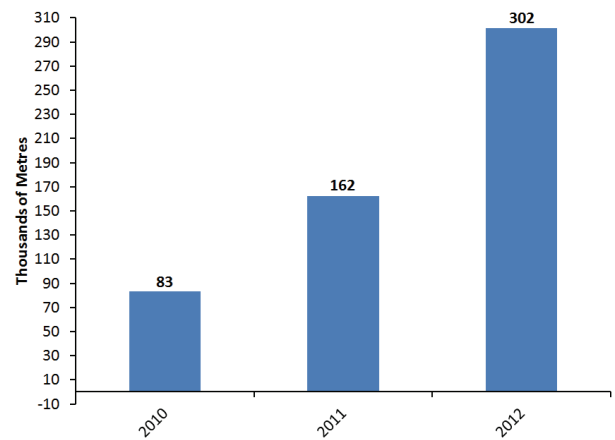


Figure 1.1. Mines and Major Exploration Projects, Omineca Region, 2012.



**Figure 1.2.** Annual exploration spending estimates in millions of dollars, Omineca Region (including three years data since redefining of the regional boundary for the 2010 report).



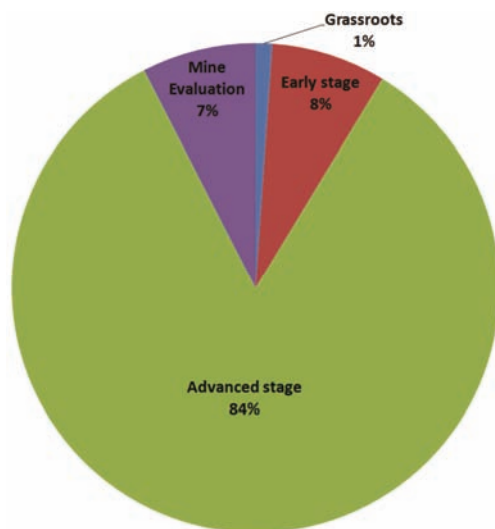
**Figure 1.4.** Annual exploration drilling estimates in thousands of metres, Omineca Region (including three years data since redefining of the regional boundary for the 2010 report).

## 1.2 MINES

### 1.2.1 Molybdenum

#### 1.2.1.1 Nechako Plateau

Thompson Creek Metals (operator and 75% owner) and Sojitz Corp's (25% owner) **Endako Mine**, 17 km west of Fraser Lake, had a challenging year due to falling molybdenum prices, temperamental equity markets and rising operating costs (Figure 1.5). A staged start-up of the



**Figure 1.3.** Exploration expenditures in 2012 by exploration stage (Grassroots: initial reconnaissance; Early stage: focused work on a target; Advanced stage: resource delineation, PEA and Prefeasibility; Mine Evaluation: focus on EA certificate, Feasibility studies, social license and government approval). Year-on-year, the Advanced stage category increased by 8%, whereas Grassroots decreased by 8%.

new mill began in January, and commercial production was achieved in early February. Construction of the regrind circuit and pebble crusher was completed in late March, and the mill reached design capacity throughput. The mill is designed to increase throughput levels by 77% to 52 000 tonnes/d, increase yearly input levels to 6.8 - 7.3 million kg (15 - 16 million lbs), and reduce operating costs. Concentrate and recovery grades were expected to reach design capacity in the second quarter. Expected recovery from the mill is 80%, with a final concentrate product of 91.5% MoS<sub>2</sub>. The mine also added two new haulage trucks. Total capital expenditure for the Endako expansion is estimated at \$650-655 million, with \$62 million locked-in for 2012.

In early May, the company reported an operating loss reflecting a year-on-year 57.3% drop in production and higher start-up and commissioning costs of the new mill. In June, recovery was not meeting design specifications, and a team of outside experts and internal technical specialists evaluated the situation. Additionally, lower ore grade than expected was reported and budgeted levels for the second quarter were not met. To increase production and recovery rates, and decrease costs, in July the company decided to suspend mining the West Denak pit and started processing stockpiled ore, which is planned to continue into 2013. Production guidance was lowered to about 2.9 - 3.4 million kg (6.5 - 7.5 million lbs) for 2012. The decision included trimming 20 full-time and 40 temporary jobs. Operating losses continued into the third quarter, with mill performance falling below forecast, and production being further complicated by processing the oxidized, stockpiled ores. Work continued throughout the fourth quarter to optimize plant operations, improve worker training programs and implement a more aggressive maintenance program. In spite of these setbacks, the company remains positive about the mid-to-long-term fundamentals of the market, being well-positioned to take advantage of a rally in molybdenum

**TABLE 1.1. MINE PRODUCTION AND RESERVES, OMINECA REGION, 2012**

Mine	Operator	Minfile (NTS ref)	Commodity	Deposit Type	Tonnes Mined (2011)	Tonnes Milled (2011)	Production	Proven and Probable Reserves (Effective Date)	Measured and Indicated Additional Resource (Effective Date)
Endako	Thompson Creek Metals Inc	093K 006 (093K.005)	Mo	porphyry	12 825 560 tonnes	8 947 309 tonnes	3 164 000 kg (6 977 000 lbs)	333.1 Mtonnes at 0.046% Mo (Dec 31, 2011)	63.2 Mtonnes at 0.030% Mo (Dec 31, 2011)
Mt Milligan (under construction)	Thompson Creek Metals Inc	093N 194 (093N.020)	Au, Cu	porphyry	N/A	N/A	N/A	531.8 Mtonnes at 0.31 g/t Au, 0.20% Cu (Dec 31, 2011)	247.2 Mtonnes at 0.17 g/t Au, 0.15% Cu (Dec 31, 2011)
Shasta	Sable Resources Ltd	094E 050 (094E.026)	Au, Ag	Low- sulfidation epithermal	20 000 tonnes	20 000 tonnes	<85.5 kg (<3000 oz AuEq)	5000 tonnes (Dec, 2012)	20 000 tonnes (Dec 2012)

\*Before 1989, 1.6 Mt at 2.84 g/t Au and 132.2 g/t Ag (Thiersch et al, 1997).

\*Thiersch, PC, Williams-Jones AE, Clark JR (1997) Epithermal mineralization and ore controls of the Shasta Au-Ag deposit, Toodoggone District, British Columbia, Canada. Mineralium Deposita 32:44-57



**Figure 1.5. Endako Mine – A.** Mining in West Denak pit to supply low-grade stockpile; **B.** New Semi-Autogenous Grinding (SAG) mill.

prices. The company expects to return to mining ore from the open pits during the second half of 2013.

Future mining plans include the development of a Super Pit by mining the saddle areas between the Endako, Denak East and Denak West pits; a step-back of the Endako pit; and the Northwest Extension zone pit. Permitting approval for the Super Pit expansion was received in early March. Proven and Probable reserves are 331 Mt at 0.046% Mo, containing 137.8 million kg (303.9 million lbs) of molybdenum. Measured and Indicated resources are 63.2 Mt at 0.030% Mo, containing 17.2 million kg (38.0 million lbs) of molybdenum. Mine life is forecasted to 2028.

The Endako deposit is centrally located within the Endako quartz monzonite phase of the François Lake Plutonic Suite, a Jurassic-Cretaceous component of the Endako Batholith which intruded the Stikine and Cache Creek terranes from the Late Triassic to Middle Eocene. The Late Jurassic orebody occurs as a series of en echelon, ribbon-textured quartz-molybdenite veins that change strike orientation from east-northeast to north across the deposit from southeast to northwest. The combined ore-grade zone is about 4.8 km by 0.75 km across the Endako, East Denak, West Denak, and Northwest Extension zones.



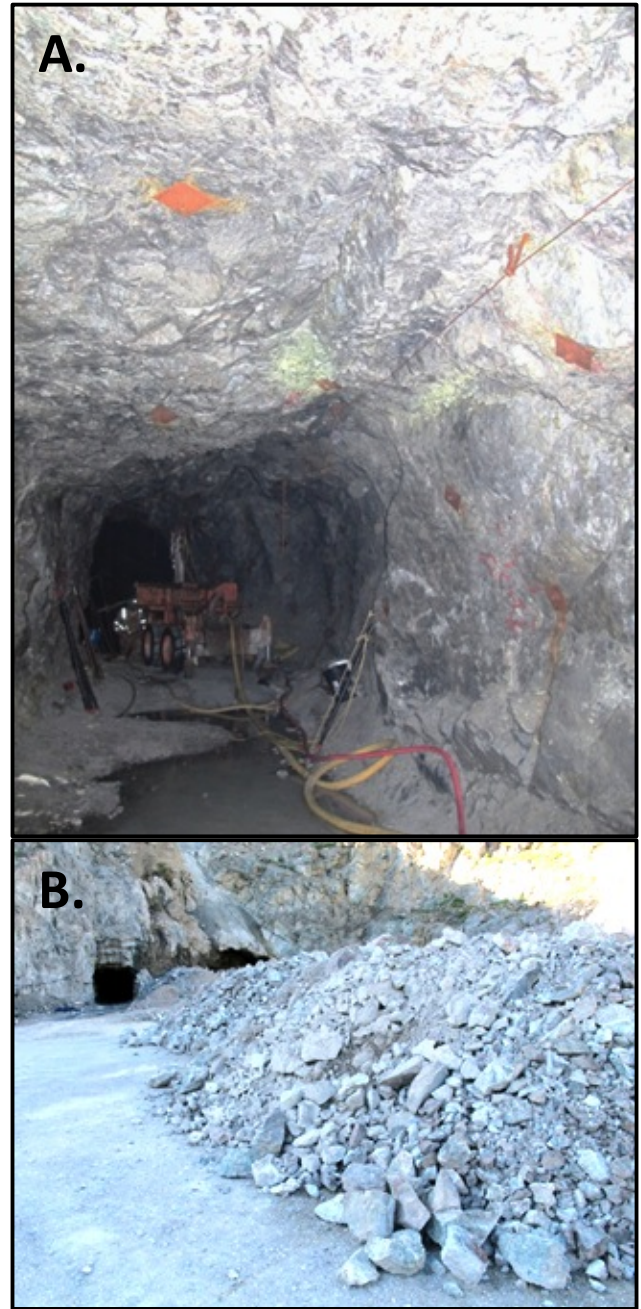
## 1.2.2 Gold-Silver

### 1.2.2.1 Toodoggone Region

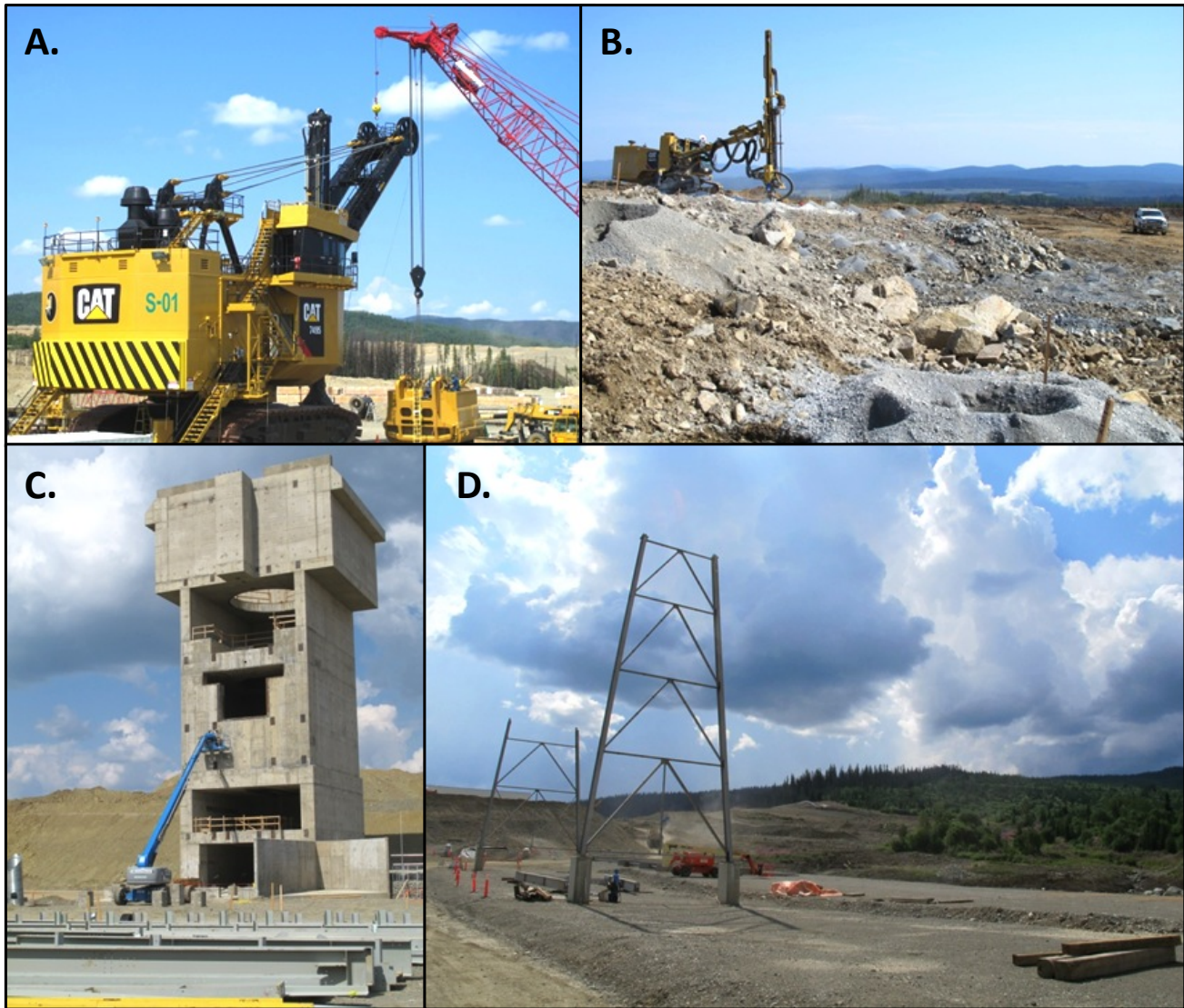
Sable Resources Ltd continued seasonal operation at the **Shasta** underground mine, 31 km north of Kemess South, from late May to October with a modest operating budget (Figure 1.6). Production was between 10 000 - 20 000 tonnes of milled ore, enough to maintain the operation. Ore is processed 11 km from the mine site at the Baker Mill, which has an optimum feed rate of 180 - 200 t/d. Generally, one pour a week produces five doré bars. Original reserves have been estimated at 1.6 Mt averaging 2.84 g/t Au and 132.2 g/t Ag (Thiersch et al. 1997). The company estimates reserves of 5000 tonnes, with the inclusive resource at 25 000 tonnes, enough to support two more years of mining. An additional 130 000 tonnes of historical resource is held nearby at the **Baker** and **Mets** properties.

Mining operations are focused in the Creek and JM zones where Au-Ag mineralized quartz-carbonate breccia veins and stockwork zones follow the north and northwest trending Shasta and J1 faults. Due to extensive stoping in the Creek zone in 2011, increased dewatering was required to access the excavation level. In the meantime, mining continued in the JM zone with a short drift to the north along the J1 structure for 2000 tonnes, and slashing of back pillars and benching off the floor of the D-stope on the 1233 level. Upon dewatering, sub-level stoping was planned for another 5000 tonnes until reaching the top of the Creek zone; mining method will then switch to cut-and-fill in close proximity to the Shasta fault. On the 1290 level, development continued at the south end of the Creek Zone with drifting toward the Shasta fault where cross-structures appear to control mineralization. A change in fault orientation is anticipated to have produced a dilatant zone favourable for mineralization. Underground drilling and blasting operations involve a small crew of a two miners. Blasting occurs every shift when excavating drifts, and longhole blasting occurs every few days as required to refill extraction points. Future exploration and mine development will follow a 20° downplunge in mineralization to the north.

The Shasta property is underlain by upper Toodoggone Formation dacitic lapilli tuff and epiclastic rocks, and Takla Formation andesites. A dacitic dome is situated east of the J1 fault and JM stope. Gold-silver bearing minerals acanthite and electrum occur in calcite-rich stage-2 veins that cut across potassic alteration and quartz-rich veins of the preceding stage. Associated silicification has increased the competency of the rock, making it amenable to underground mining.



**Figure 1.6. Shasta Mine – A.** Drilling on the 1255m level; **B.** Creek zone open-pit and ore stockpile from JM zone.



**Figure 1.7. Mt. Milligan Mine Construction project – A. Assembling electric shovel in laydown yard; B. Blast-hole drilling on MBX stock; C. Crusher tower construction; D. Struts for conveyor to mill.**

## 1.3 MINE DEVELOPMENT AND EVALUATION

### 1.3.1 Mine Development

#### 1.3.1.1 Quesnel Terrane

Despite significant challenges from lower commodity prices, high turnover of skilled labour, and rising cost of supplies, Thompson Creek Metals Inc stayed on schedule with mine construction at the **Mt. Milligan** gold-copper project, 145 km northwest of Prince George (Figure 1.7). Mine construction began in mid 2010 at an estimated

capital cost of \$915 million. In the first quarter of 2012, the company warned of 10-20% cost inflation that would push the project as high as \$1.5 billion. In May, it was announced an additional \$430 million had to be raised through a debt offering (\$200 million) and a tangible equity unit offering (\$230 million). In August, the company posted an operating loss and slump in revenues for the second quarter and sought more financing for the project by selling an additional 12.25% stake in future gold production to partner Royal Gold Inc for \$200 million, plus US\$435 an ounce on gold delivery. The transaction prevented the company from defaulting on debt covenants and brought Royal Gold's stake in production to 52.25% and increased their investment to \$781.5 million. In November, the company announced a \$350 million Secured Senior Notes offering in part to fund Mt. Milligan capital expenditure, and the closing of

**TABLE 1.2. MAJOR EXPLORATION PROJECTS, OMINECA REGION, 2012**

<b>Property</b>	<b>Operator</b>	<b>Minfile (NTS ref)</b>	<b>Commodity</b>	<b>Deposit Type</b>	<b>Work Program</b>
3Ts	Independence Gold Corp	093F 055, 068 (093F.005)	Ag, Au	Low-sulfidation epithermal / vein	DD (3500m), G, GC (rock), P
Ahbau Creek & Lake	Williams Creek Gold Ltd	093G 007 (093G.019)	Au, Ag, Cu, Zn	Polymetallic vein and PGE	DSM, G, GC (rock, soil)
Akie	Canada Zinc Metals Corp	094F 031 (094F.036)	Zn, Pb, Ag	SEDEX	AB-EM (355 line-km), EN, GC (hyd)
Aley	Taseko Mines Ltd	094B 027 (094B.042)	Nb	Carbonatite- hosted	BU (600 kg), GD (2500 m), EN, FS, MS, TP (15 pits)
Aspen East & West	Redhill Resources Corp	093F 060 (093F.038)	Au, Ag, Zn, Pb, Cu, Mo	epithermal, vein	GC (rock, soil, silt, bio), IP (57.8 line-km)
Bandit	Copper Creek Gold Corp / Stina Resources Ltd	(093F.008, 009, 018, 019)	Cu, Ag, Au, Mo	porphyry	A, GC (soil), PD (1402 m)
Big Bear	Parlane Resource Corp	(093F.035,036,025, 026)	Au, Ag	Low-sulfidation epithermal	DD (1620), GC (soil, silt, rock), IP (14 line- km), MG
Blackwater Gold Project	New Gold Inc	093F 037 (093F.016, 026)	Au, Ag	Low-sulfidation epithermal	A, DD (196 606 m), CD/GD (40 000 m), EN, FS, G, GC (soil, till), TP
Blackwater East & West (Dave 2)	RJK Explorations Ltd	093F 037 (093F.016,)	Ag	Low-sulfidation epithermal	A, DD (2370 m), GC (soil), IP (18.5 line-km), MG, P
Blackwater East (Kuyakuz Mtn)	Driven Capital Corp	(093F.018, 028)	Au, Ag, Zn, Pb, Cu	Low-sulfidation epithermal, porphyry	A, IP (30 line-km), MG (30 line-km)
Capoose	New Gold Inc	093F 040 (093F.024, 025, 034, 035)	Ag, Au	Low-sulfidation epithermal	A, DD (10 894 m), TR
Captain	Orestone Mining Corp	093J 026 (093J.081, 093K.090)	Cu, Au	Alkalic Porphyry	DD (1500 m)
Cathedral	Thane Minerals Inc	094C 018, 048 (094C.003, 012, 013, 022, 023)	Cu, Au	Alkalic Porphyry	G, GC (rock, soil, silt)
Choo	Serengeti Resources Inc	093N 131 (093N.019)	Cu, Au	Porphyry	DD (1301 m)
Copley	Northern Vertex Mining Corp	093F 070 (093F.076)	Au	Low-sulfidation epithermal	A, DD (1200 m)
Decar	Cliffs Natural Resources Inc	093K 041 (093K.094)	Ni	Ultramafic	A, DD (15 205 m), EN, GD (1473 m), MS, PEA
Frog	International Samuel Exploration Corp	094L 014 (094L.005)	Cu, Au, Ag, Mo	Porphyry	*AB-MG (1029 line- km), GC (rock, silt), P
Galileo	Amarc Resources Ltd	(093C.083, 084, 093, 094, 095; 093F.004)	Au, Ag, Cu	Low-sulfidation epithermal, porphyry	AB-MG (600 line-km), G, GC (soil), IP (86 line-km)
Groundhog	Atrum Coal	104A 087 (104A.089)	Anthracite	Sedimentary	CQ, DD (4580), PEA
Hoof	Porpoise Bay Minerals Ltd	093G 018 (093G.071, 081)	Mg, Ni	Ultramafic	A, DD (1500 m)
Hubble	Amarc Resources Ltd	(93F.048)	Au, Ag, Cu	Low-sulfidation epithermal, porphyry	A, AB-EM/AB-MG (33 line-km), DD (700 m)
JD	Tower Resources Ltd	094E 171 (094E.045)	Au, Ag, Zn, Pb	Low-sulfidation epithermal	DD (3000 m), G, GC (soil)

continued on the following page



TABLE 1.2. (CONTINUED)

Property	Operator	Minfile (NTS ref)	Commodity	Deposit Type	Work Program
Kechika Regional (Pie & Mt. Alcock)	Canada Zinc Metals Corp	094F 023 (094F.045, 046, 063, 064)	Zn, Pb, Ag	SEDEX	AB-EM (1161 line-km), GC (hyd)
Kemess Underground	AuRico Gold Inc	094E 021 (094E.007)	Cu, Au	Porphyry	EN, FS, R
Key	Troymet Exploration Corp	093F 069 (093F.006)	Au, Ag, Zn, Pb, Cu, Mo	Low-sulfidation epithermal, porphyry	A, DD (867 m), G, GC (soil), IP (9.6 line-km), P
Klow	First Point Minerals Corp	093N 245 (093N.042, 043)	Ni	Ultramafic	DD (1579 m), MG
Km 26	Fort St James Nickel Corp	093K 113 (093K.087)	Ni	Ultramafic	*DD (813 m)
Kwanika	Serengeti Resources Inc	093N 073 (093N.054)	Cu, Au	Alkalic Porphyry	DD (1472 m), IP (3 line-km), PEA
Lustdust	Alpha Gold Corp	093N 009 (093N.053)	Cu, Au, Ag, Zn	Skarn	*AB-EM/*AB-MG, *G, *GC (rock, soil), *P
MAC	Stratton Resources Inc	093K 097 (093K.083)	Cu, Mo, Ni	Mo porphyry (Low F-type), Ni-alloy	GC (rock, soil - 22.4 line-km)
Manson Creek Group	Angel Jades Mines Ltd	(093N 068)	Au	Vein	G, GC (rock), TR
Mex	Gold Fields	094E 057 (094E.027)	Cu, Au	Alkalic Porphyry	DD (2200 m)
Mugaha	QMC Quantum Minerals Corp	(930.045, 046)	Au	Vein	TR (1064 m), G, P
OGK	Tajiri Resources Corp	093A 040 (093A.061)	Cu, Au	Alkalic Porphyry	AB-MG/AB-RD/AB-EM (505 line-km), GC (rock)
PG	Porpoise Bay Minerals Ltd	(093G.054, 055, 064, 065)	Au	Vein	A, AB-EM/AB-MG (76 line-km), TR
Quesnel Trough / QUEST	Xstrata Copper Canada Inc	(093G, J, K)	Cu, Au, Mo	Porphyry	A, G, GC (soil), IP (77 line-km), P
Ruby	Brocade Metals Corp	094C 022 (094C.025,015)	Ag, Au, Zn, Pb	Vein	DD (640 m)
Tacheeda Lake	International Montoro Resources Inc	093J 019 (093J.078)	Nb, REE, Ta	Carbonatite-hosted	AB-MG/AB-RD (989 line-km)
Tagai	Strategic Metals Ltd	093G 075 (093G.041)	Au, Cu	porphyry	RC (1000 m)
Tas	Rich Rock Resources	093K 110 (093K.099)	Cu, Au	Alkalic Porphyry	A, 3D-IP, MG
Tchentlo	Serengeti Resources Inc	093N 235 (093N.017)	Cu, Au	Porphyry	DD (1513 m)
Trout	Venerable Ventures Ltd	093F 044 (093F.067)	Au, Ag	Low-sulfidation epithermal	DD (2200 m), G, GC (rock, soil), IP (75 line-km), P
Zakco	Strategic Metals Ltd	093F 029 (093F.076)	Au, Ag, Cu	Low-sulfidation epithermal	RC (1000 m)

**Work Program Abbreviations:**

A = access (trail, road construction on claims); AB-EM = airborne electromagnetics; AB-MG = airborne magnetics; AB-RD = airborne radiometrics; BU (X tonnes) = bulk sample (weight in tonnes if known); CD = condemnation drilling; CQ = coal quality testing; DD (Xm) = diamond drilling (totalling X metres); DSM = digital surface model; EN = environmental baseline studies/monitoring, remediation work; FS = Feasibility studies; G = geology, mapping, etc.; GC = geochemical sampling (rock, silt, soil, till, biogeochemical, hydrogeochemical etc.); GD = geotechnical drilling; GP = geophysics (general); IP (X line-km) = induced polarization (totalling X line-kilometres); 3D-IP; MG = magnetics; MS = metallurgical studies; P = prospecting; PEA = Preliminary Economic Assessment, scoping study; PD = percussion drilling; PF = Prefeasibility studies; R = reclamation; RC = reverse circulation drilling; TR = trenching; TP = test pits; \*indicates work from 2011 that was either late in the year or previously unreported



its revolving credit facility. In addition to financial re-arrangements, the company also applied to amend its Environmental Assessment (EA) Certificate to include provisions for a 450-person camp on site during the operational phase, and to lease the Kemess Mine load-out facility in Mackenzie instead of constructing a new facility in Fort St. James.

Over the nine months ending Sept 30, \$492.2 million was spent on mine development and construction of the processing plant. The company reports capital expenditure covered construction of the tailings storage facility (TSF), buildings, and facilities (concentrator, truck shop, administration building, primary and pebble crushers), plant site earthworks, cement works, steel erection, construction camp costs, mine development, mining equipment, and engineering design costs. Mining equipment was on ground in January 2012, and by August eight 797 haul trucks were on site. Drilling and blasting of the MBX stock started in July with small shots and test patterns, with mined material to be used for tailings construction. Since the inception of the project, \$935 million has been spent on a cash basis as of Sept 30, with an expected \$515 - \$585 million remaining to be spent before project completion in Q3 2013 and commercial production in Q4 2013.

The Mt. Milligan mine will be an open-pit operation with 60 000 t/d copper flotation concentrator. Average annual production over the current 22-year mine life is expected to be 37 million kg (81 million lbs) of copper and 5460 kg (194 000 oz) of gold. The first six years production will be higher averaging 40 million kg (89 million lbs) of copper and 7428 kg (262 000 oz) of gold. Life-of-mine strip ratio is 0.84:1. Once achieving design production capacity, the mine is expected to account for 50% of Thompson Creek revenue, and will diversify the company from being a pure-play molybdenum producer, adding copper and gold as a hedge against commodity price cycles. The combined Main and Southern Star deposits have a resource of 706.7 Mt (Measured and Indicated) at 0.33 g/t Au and 0.18% Cu, containing 212 621 kg (7.50 million oz) Au, and 1288 million kg (2.84 billion lbs) Cu. Reserves are 531.8 Mt (Proven and Probable) at 0.31 g/t Au and 0.20% Cu, containing 170 948 kg (6.03 million oz) Au, and 963 million kg (2.12 billion lbs) Cu. This represents the second largest gold reserve in Canada. The Mt. Milligan Mine will be the first greenfield metal mine in British Columbia since the Max Molybdenum mine in 2007, and the Huckleberry and Kemess South mines in 1997. There were approximately 900 people working at the site in 2012 including and contractors. The permanent operations workforce is expected to number about 350.

The Mt. Milligan property is underlain by Late Triassic Witch Lake succession basaltic-andesitic rocks of the Takla Group. Westerly-dipping monzonitic stocks, the MBX and Southern Star, are central to mineralization. Copper-gold mineralization in sulfide veinlets and disseminations is hosted in the stocks, their brecciated margins, and in the adjacent volcanics concentrated along conformable horizons and the monzodiorite Rainbow Dike. In the Main deposit, potassic alteration and Cu-Au mineralization gives way to Au-only mineralization and carbonate-rich phyllic-intermediate argillic alteration in the 66 zone, southeast of the Rainbow Fault.

### 1.3.2 Mine Evaluation

#### 1.3.2.1 Toodoggone Region

AuRico Gold Inc awaited results of a Feasibility Study for a decision on the **Kemess Underground** project 5.5 km north of the past-producing Kemess South mine and 294 km northwest of Mackenzie. Completion of the study is expected for late 2012. In the meantime, environmental baseline studies and negotiations with First Nations continued, as did reclamation and closure work on Kemess South that included: finishing the spillway; rehabilitating borrow areas; re-sloping/vegetating areas around the dam; road reclamation; ditching; waste dump planting; and fisheries and water quality monitoring. In a 2011 PEA study, Northgate Minerals Corp updated the resource estimate to 136.5 Mt at 0.56 g/t Au, 0.29% Cu, 2.11 g/t Ag (Indicated); and 6 Mt at 0.42 g/t Au, 0.22% Cu, 1.65 g/t Ag (Inferred). The study outlined an 8 Mt/y underground block caving operation with a single extraction level. Average annual gold production is estimated at 2693 kg (95 000 oz), and copper at 18.8 million kg (41.4 million lbs). Total mineable tonnage is approximately 88 Mt. The mine, with a projected 12 year life, would utilize a permitted area for tailings, and existing infrastructure and mill facilities at Kemess South. Twin drifts would convey crushed ore from underground, provide access into the mine, and ventilation intake-return.

Porphyry-style copper - gold - molybdenum mineralization occurs as early and main-stage veins with potassic and phyllic alteration in the Kemess North quartz diorite-quartz monzonite (part of the regional Early Jurassic Black Lake Intrusive suite) that underlies the East Cirque area, and to a lesser degree in proximal Takla Group andesite/basalt flows and tuffs.

## 1.4 EXPLORATION HIGHLIGHTS

### 1.4.1 Porphyry Copper, Gold and Molybdenum Projects

#### 1.4.1.1 Quesnel Terrane (Cu-Au porphyry)

Porphyry copper prospects in north-central BC are hosted in the Quesnel arc, a volcanic terrane that accreted to ancestral North America in the Early-Middle Jurassic, and the Stikine terrane, the east margin of which represents the Toodoggone district. The Omineca Region comprises the northern 300 km of this intermediate volcanic belt, which extends over 1000 km throughout much of central BC. The arc had a two-phase development. The Early Triassic Takla Group comprises of basal sedimentary rocks that grade upward through inter-fingering volcanic successions, including the Inzana Lake and Witch Lake successions. These are overlain by Early Jurassic, partially subaerial volcanic suites laid down on a more mature arc. Coeval intrusions, including the batholithic Hogem intrusive complex, are distributed throughout the area and generally shift from more alkaline compositions in the Early Mesozoic to more subalkaline in the Cretaceous. The northwest trending Pinchi and Manson Creek faults bound the northern Quesnel trough on the west and east sides respectively. Gold-copper  $\pm$  molybdenum porphyry deposits of both alkalic and high-potassic calc-alkaline affinity are known within the region.

Serengeti Resources Inc conducted a follow-up drill program at their **Kwanika** property, 150 km north of Fort St. James. Three holes tested an IP geophysical anomaly that extends up to 800 m north of the Central Zone, and where good Cu-Au grades have been intersected in wide-spaced drilling. Drilling over a 400 km strike length confirmed the system remains open to the north and at depth. One additional drill hole tested a strong IP and magnetic anomaly 15 km south of the Central Zone area. An IP survey east of the Central Zone was also completed. In early 2012, Serengeti reported the start of an independent PEA study on the higher grade Cu-Au resource at Kwanika. The study will investigate a 15 000 t/d, combined open-pit and underground operation. The resource estimate as of March 2011 is 243.6 Mt at 0.23% Cu and 0.21 g/t Au, containing 558 million kg (1.23 billion lbs) of copper and 47 000 kg (1.66 million oz) of gold in the Indicated category, and 295.1 Mt at 0.19% Cu and 0.10 g/t Au, containing 567 million kg (1.25 billion lbs) of copper and 26 000 kg (0.91 million oz) of gold in the Inferred category. The Kwanika Project consists of two porphyry deposits, the Central Zone (Cu-Au) and the South Zone (Cu-Mo-Au-Ag), separated by 2 km along a northwest trend paralleling the Pinchi Fault. Both are associated with

potassically altered alkaline-to-intermediate intrusive rocks of the Hogem complex.

Serengeti also conducted a 12-hole drill program financed by Freeport-McMoRan of Canada Ltd at **Tchentlo** and **Choo**, 86 km northwest of Fort St James, to test seven targets (Figure 1.8). At **Tchentlo**, three drill holes exploring coincident IP/magnetic and Cu-Mo-Au-Pt soil anomalies encountered scattered anomalous gold, and several zones of structurally controlled Cu-Mo mineralization hosted in diorites and gabbro. At **Choo**, three holes exploring IP targets within the transition from Inzana Lake to Witch Lake volcanics (including the historic Camp target) encountered gold-anomalous intervals at or near contacts within intercalated hornblende andesite-latite porphyry, volcanoclastic rocks, and feldspar porphyry dikes. The project area follows a 60-km long east-west trending flexure of the Hogem intrusive complex that is evident in regional magnetics.

In January, Orestone Mining Corp announced the results of a drilling program at **Captain**, 46 km northeast of Fort St. James. The program targeted a large Cu-Au porphyry system over a 3.25 km strike length across an interpreted intrusive. Drilling intercepted over 400 m of fine disseminated sulfide, and zones of fracture controlled sulfide with altered volcanic rocks and monzonite. Follow up petrography on mineralized samples suggests a Fe-oxide/Fe-carbonate potassic-to-phyllitic assemblage similar to the Au-rich zone at Mt. Milligan. Previous geophysical results (chargeability-resistivity high on the eastern flank of a 5 km-scale magnetic high) and this drilling has further defined the 1 x 3 km East Target area. Two other similar targets have been determined by geophysical survey within a 50 km<sup>2</sup> potential system. Outcrop is rare and overburden is 20-40 m deep over the East Target area. In November, a 3-hole drill program on the East Target was underway, and site preparation for over 38 newly approved drill sites.

At the **OGK** property, 194 km north of Fort St James, Tajiri Resources Corp completed an airborne geophysical survey with follow-up geochemical sampling program in September. Sampling focused primarily on the Slide Mountain area where Cu-mineralized shear zones have historically been drill tested in the Duckling Creek syenite complex near the OGK claim boundary. Anomalous Cu-Au in outcrop was confirmed by the sampling. The OGK property lies 8 km northwest of the Lorraine deposit.

Rich Rock Resources completed a ground IP and magnetics survey of the **Tas** property, 50 km north of Fort St. James. In February, the company reported preliminary results of a 3D-IP survey that showed anomalous chargeability over a 750 x 250 m area in the Ridge zone which is also associated with elevated Cu-Au in soils over 2500 x 1000 m, and K and Th/K anomalies. Three other IP targets were developed including the 900 x 300 m Southeast target at the northeast margin of the Tas pluton that also has a 1100 x 300 m copper-in-soil anomaly. A large deep IP target partially overlaps both the Ridge



**Figure 1.8. Tchentlo/Choo project – A.-C. Serengeti Resources team demobing, airlifting samples and supplies.**



Zone and Southeast targets. The property is underlain by cherty tuff and argillite of the Inzana Lake Formation and the dioritic Tas pluton. A northeast trending porphyry dike swarm with associated breccias and shear zones cuts the Ridge zone.

Drilling programs were postponed in Xstrata Copper Canada Inc's **Quesnel Trough** regional project while an MOU with First Nations was being negotiated. In 2011, a multi-stage porphyritic monzonite was drilled at **Inza** with some elevated Cu-Au and near ore-grade Mo values (Figure 1.9). The property, 54 km northwest of Fort St. James, is optioned from Strongbow Exploration Inc. Elsewhere, an IP survey was conducted on **Pilot Mountain (Block 10)**, 18 km northwest of Prince George, where 2011 drilling intersected monzonite porphyry on North Pilot Mt; and 10 km to the north, drilling was planned to test a magnetic low anomaly at **Eye**, under option from Kiska Metals Corp. Grassroots and early stage work involving IP surveys and MMI soil sampling was completed on **Block 12** and **Lynx**, near Prince George and Fort St. James. Similar work was completed on the Serengeti Resources/Fjordland Exploration Inc **QUEST JV** properties **Rob**, **ST**, **PG**, **MP**, and **Ping** near Prince George. Drill testing an IP anomaly at **Ping** was also on hold.

In March, Williams Creek Gold Ltd acquired the **Ahbau Creek** (G-South) property, 26 km north of Quesnel, from New Gold Inc. The company commissioned a remote sensing satellite survey to produce a high-resolution digital surface model for revealing structural lineaments, and a soil survey was completed by mid October. Mineralization (Au-Ag-Cu  $\pm$  Zn) in disseminated, fracture-controlled and massive sulfide has historically been reported along a northwest-trending shear zone for over a kilometre. The area is underlain by mafic-intermediate Takla Group rocks intruded by several rhyolite dikes, and the Cretaceous Naver intrusive suite. Nearby, the company staked and sampled **Ahbau Lake**, a gossanous target with historically reported elevated Platinum Group Element values on the lake's southwest shore close to the Spanish Thrust fault, a major crustal break.

Other properties underlain by the Hogen intrusive complex that had geochemical sampling and/or reconnaissance programs include Kiska Metal Corp's **Redton**, West Cirque Resources Ltd's **Heath**, and Thane Minerals Inc's **Cathedral**, located 100 km, 108 km and 210 km northwest of Fort St. James. Lorraine Copper Corp provided an initial resource estimate for the Main and Bishop zones at **Lorraine**, 170 km north of Fort St. James, with 6.4 Mt at 0.61% Cu and 0.23 g/t Au (Ind.), and 28.8 Mt at 0.45% Cu and 0.19 g/t Au (Inf.), at a 0.2% Cu cut-off. Newton Gold Corp compiled soil sampling data to develop 1.2 x 1.8 km nested Au-Cu anomaly at **Chuchi** (Chuchi Lake), 90 km north of Fort St. James, where Chuchi Lake Formation sedimentary rocks (Takla Group) are intruded by porphyritic monzonite stocks. West of the Pinchi Fault and Hogen complex, Alpha

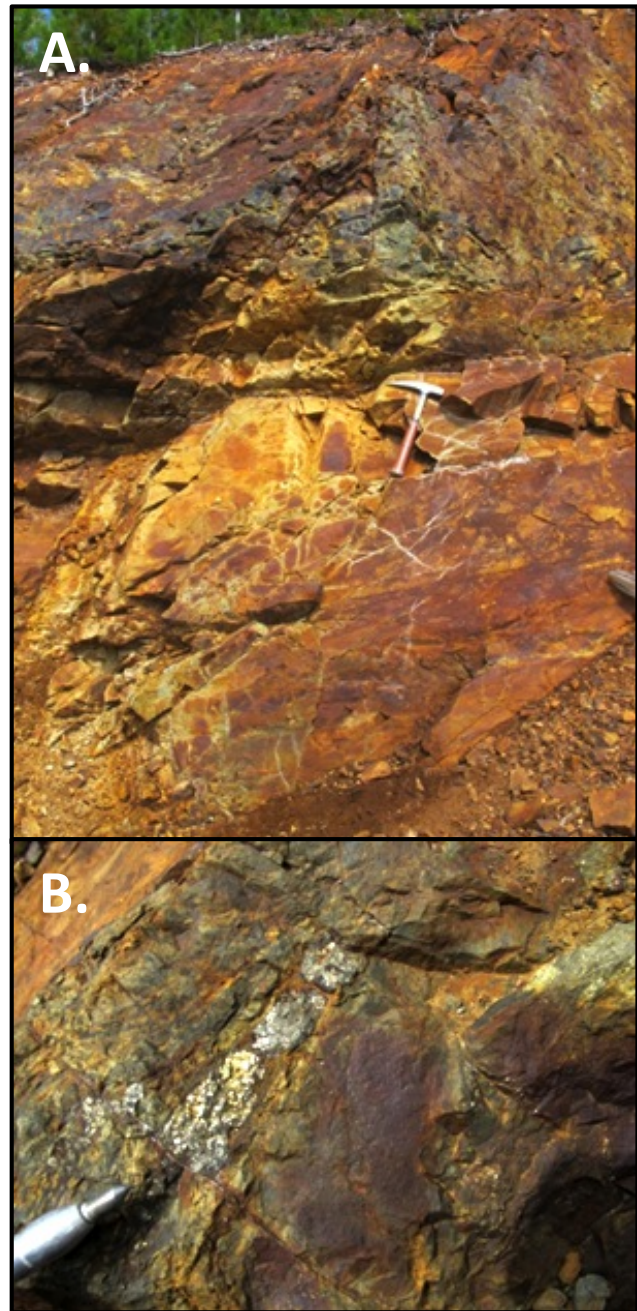


Figure 1.9. Inza project – A. 310°/-40° contact in North Inza with monzonite below and Inzana Fm. siltstone above, on southwest side of ridge; B. Pyrite-pyrrhotite veining in siltstone at North Inza.

Gold Corp compiled and analyzed data from the 2011 geophysics-geochemistry program at **Lustdust**, 144 km northwest of Fort St. James. Ten target zones outside the Canyon Creek garnet-diopside Cu-Au-Ag-Zn skarn deposit have been identified. The property is underlain by upper Paleozoic Cache Creek Group rocks intruded by the Eocene Glover monzonite stock. A resource estimate for the deposit was provided in 2010.



#### 1.4.1.2 Toodoggone Region (Cu-Au porphyry)

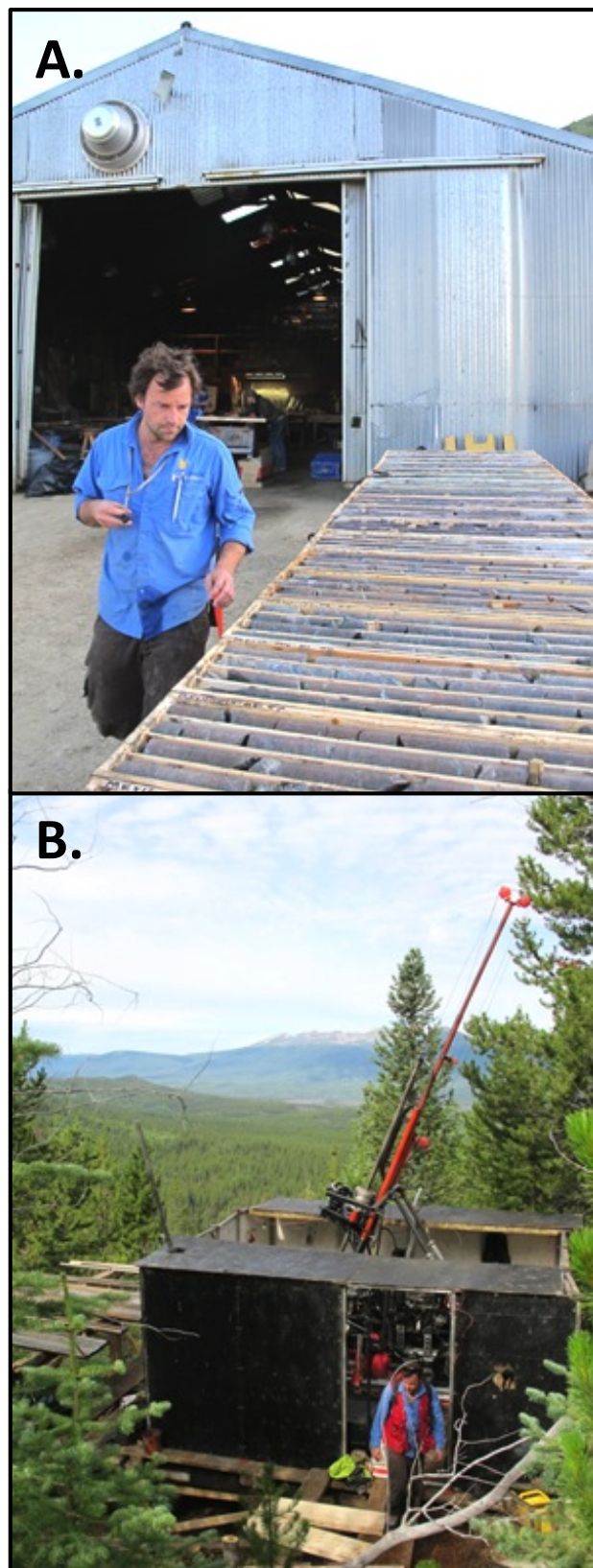
Gold Fields ran a drill program at **Mex**, part of the Toodoggone project under option from Cascadero Copper Corp, to test a magnetic anomaly and explore deeper (to 332 m) into the known Mex system located 23 km north of Kemess South (Figure 1.10). Drilling encountered lithic-crystal tuff and latite dikes of the Lower Toodoggone Formation; and monzonite to monzodiorite intrusive with minor quartz-sulfide veinlets. Hole ME-12-008 showed early stage magnetite-biotite-quartz veins overprinted by pervasive phyllic alteration with gypsum, laumontite and late calcite veins. Copper mineralization may be transitional between the potassic alteration stage and phyllic overprint.

Grassroots exploration programs included International Samuel Exploration Corp's **Frog** project, 107 km north of Kemess South, where geochemical sampling and prospecting followed up a 2011 airborne magnetic survey and sampling program that identified copper and copper-molybdenum anomalies. Gold-silver enriched quartz veins with copper sulfide occur in quartz diorite/granodiorite of the Early Jurassic Pitman Batholith. Twenty-two km east of Kemess South, Orestone Mining Corp collected geochemical samples at **LaForce**, a 20 km northwest trending geochemical gold anomaly with a 1000 x 20 m silicified-sericitized zone of pyritic stockwork with minor chalcopyrite.

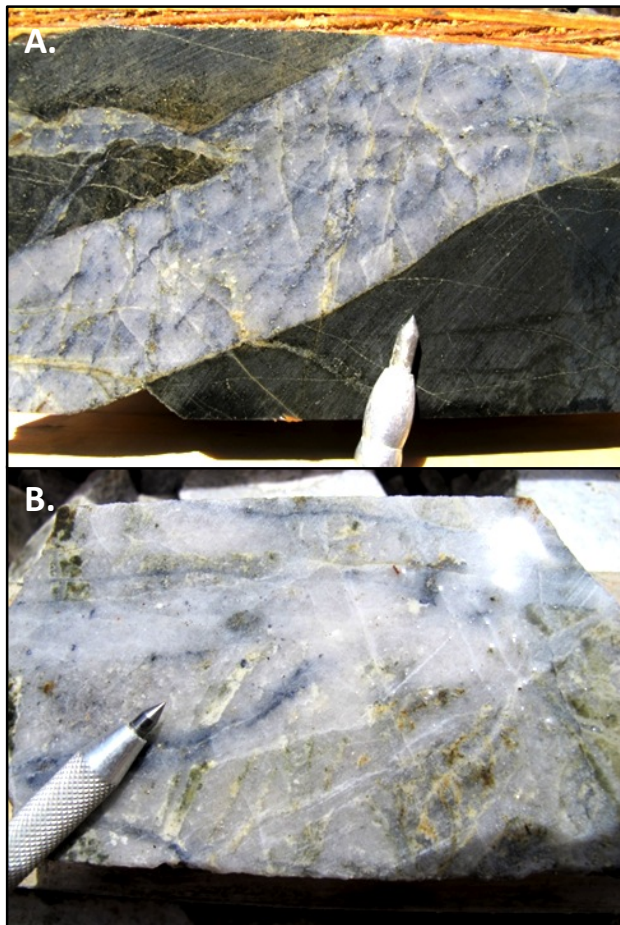
#### 1.4.1.3 Nechako Plateau (Mo-Cu porphyry)

In April, Stratton Resources Inc provided an initial resource estimate for the **MAC** project, 80 km northwest of Fort St. James, with an Indicated 70.4 Mt at 0.063% Mo and 0.10% Cu (Figure 1.11). A near-surface high grade starter zone of 15.5 Mt at 0.104% Mo and 0.05% Cu is also categorized as Indicated. The Inferred resource is 177.9 Mt at 0.042% Mo and 0.05% Cu. In August, a soil survey covered the Peak zone, west of the Peak zone, and the west part of the Camp zone. The 700 x 500 m Camp zone is the most advanced of three targets. Quartz-molybdenite veins and veinlet stockwork are hosted in the potassically-altered margin of a porphyritic quartz-monzonite intrusive, and 50 - 90 m outward into biotite hornfelsed basaltic-andesitic host rocks. Within the Camp zone, the East Contact and Northwest Contact subzones represent two lobes of higher grade mineralization. The MAC property is underlain by Mississippian to Late Triassic volcanic/volcaniclastic rocks of the Cache Creek and Rubyrock Complexes, and Late Jurassic to Early Cretaceous François Lake Suite intrusives of the Endako Batholith.

Other molybdenum porphyry projects in the area saw limited work. TTM Resources Inc collected a 6 tonne bulk sample for metallurgical testing at **Chu**, 80 km southwest of Vanderhoof. The project is in the Pre-Application stage of the EA process where it is described



**Figure 1.10. Mex project – A.** Geologist Tim Stubly of Gold Fields assesses new drilling; **B.** Visiting drill on west side of Mex Ridge.



**Figure 1.11. MAC project** – A. quartz-molybdenite-pyrite-chalcopyrite vein cutting hornfelsed volcanics, drill hole MC-1110 at 182 m; B. Dense quartz-molybdenite-chalcopyrite stockwork in quartz monzonite, drill hole MC-1117 at 245 metres.

as a potential open-pit operation with production up to 90 000 t/d and an expected 20 year mine life. Quartz-molybdenite stockwork veinlets occur in the northeast margin of the CH pluton, in surrounding hornfelsed siltstone-argillite of the Jurassic Hazelton Group, and in feldspar-porphyry dikes that appear to be genetically related to the pluton. The mineralized zone is a 1700 x 400 m northeast dipping irregular tabular body with up to 700 m depth. At **Nithi Mountain**, 9 km south of Fraser Lake, Leeward Capital Corp conducted a brief exploration program in August to test the REE potential of a pegmatite on the east side of the property. The property is underlain by the granodioritic François Lake Plutonic Suite in which the Nithi quartz monzonite phase has been extensively faulted and brecciated in a 2 km wide northeast trending zone that hosts five vein-mineralized subzones. Coincident anomalous geochemical-geophysical circular features suggest small buried intrusions that appear to be related to mineralization. Both projects have Indicated/Inferred resource estimates from 2010 and 2011 respectively.

## 1.4.2 Epithermal Gold-Silver and Vein-type Projects

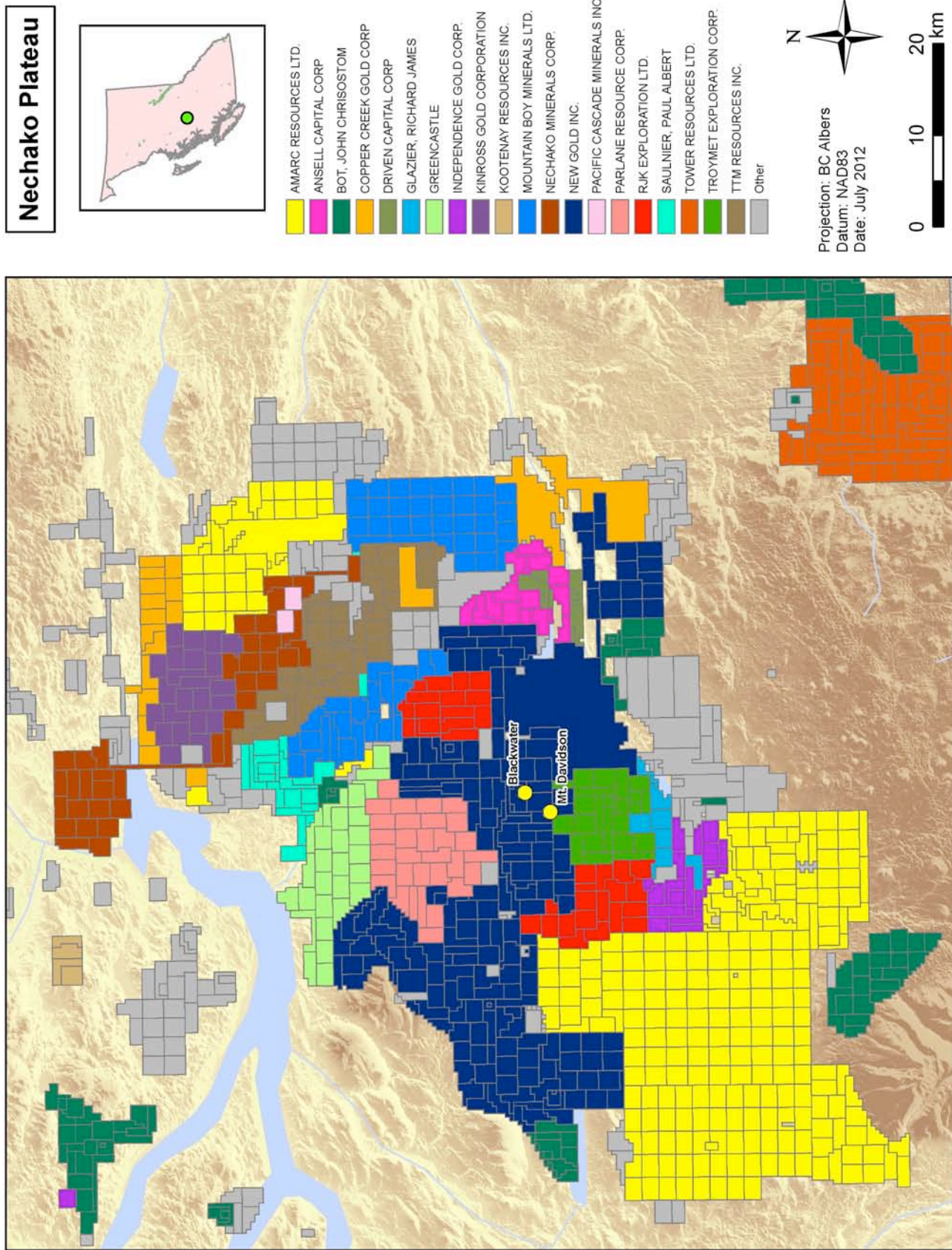
### 1.4.2.1 Nechako Plateau

The Nechako Plateau, part of the Interior Plateau physiographic province, is an area of moderate relief bound to the north by the Skeena Arch, to the west by the Coast Mountains, and to the east by the Cache Creek terrane. The area is underlain by Early-Middle Jurassic Hazelton Group island-arc volcanic rocks of the Stikine Terrane. Bowser Lake Group sedimentary and volcanic rocks were deposited from Late Jurassic to Early Cretaceous with the uplift of the Skeena Arch and development of the Bowser Basin to the north. Continental arc volcanism and intrusion of granodioritic plutons, including the Capoose Batholith, occurred during a Late Cretaceous orogenic event. Episodic volcanism continued into the mid-Eocene with eruption of the intermediate Kasalka (Late Cretaceous), felsic Ootsa Lake, and intermediate Endako Groups. Eocene volcanism appears to be closely linked with regional crustal trans-tension and basin-and-range style block faulting. The Chilcotin Group represents Miocene and younger volcanism forming lava fields of transitional basalts. Glacial till, colluvial, and fluvial deposits cover the area with bedrock exposures generally restricted to higher elevations.

In December 2011, New Gold Inc acquired Silver Quest Resources Ltd and their interest in the Davidson property, thus consolidating a 100% ownership in **Blackwater-Davidson**, now the **Blackwater Gold Project** (Blackwater), 110 km south of Vanderhoof in the Fawnie Range on the north slope of Mt. Davidson. The acquisition included the **Capoose** property, 25 km northwest of Blackwater. In March, the company acquired the **Auro** and **Auro South** properties directly southeast of Blackwater from Gold Reach Resources Ltd. The two acquisitions increased New Gold's land position, which is now over 1000 square km, giving the company more flexibility in locating infrastructure, as well as increased exploration potential (Figure 1.12).

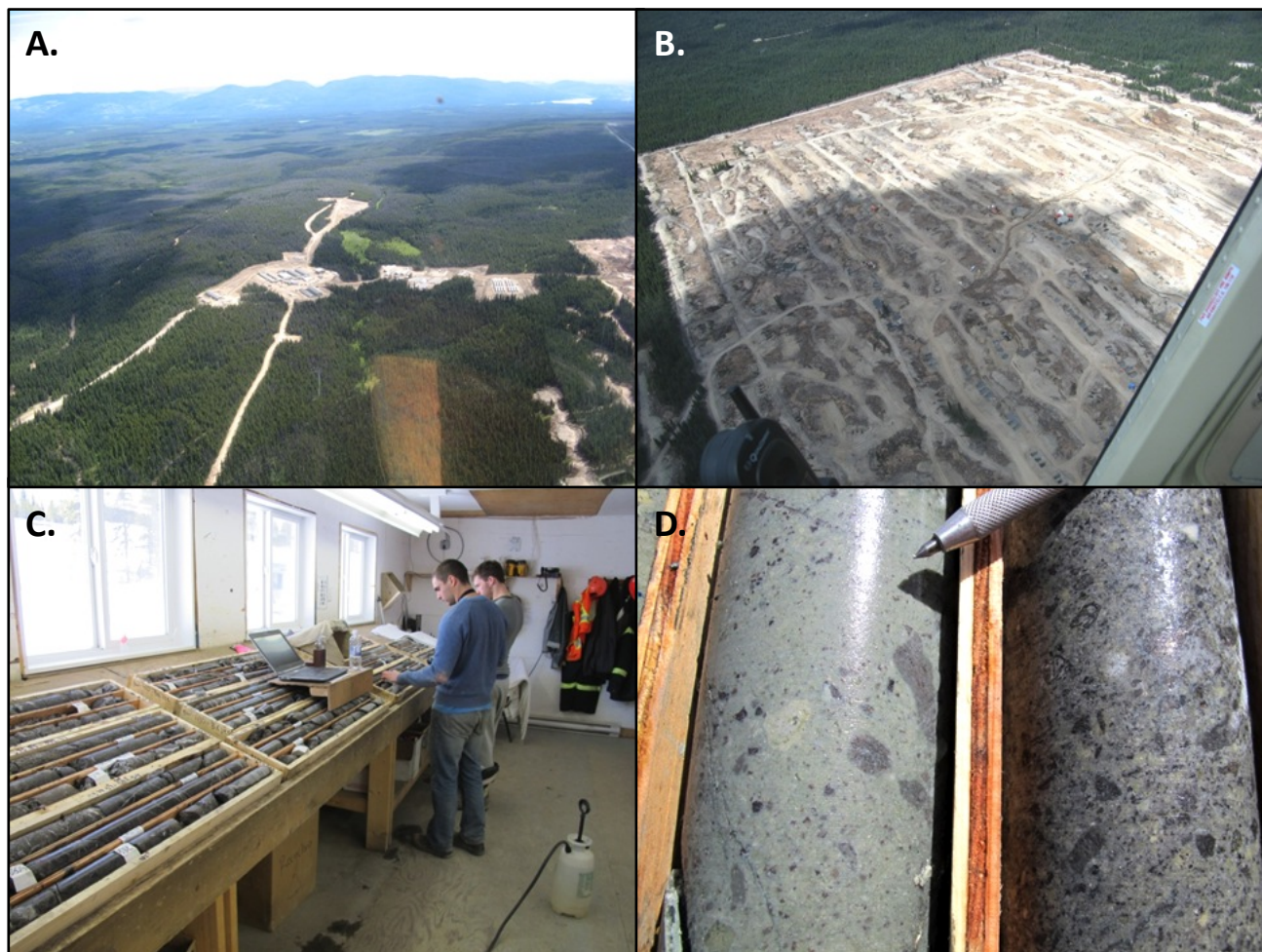
The budget for New Gold's **Blackwater** drilling project, which included over 800 holes and 247 500 metres, was \$86 million (Figure 1.13). Additional expenditure for camp construction, infrastructure development, equipment and other capital purchases brought the total exploration budget to about \$129 million. By June, Blackwater had become the largest exploration project in BC with 18 drills on site (13 infill, 2 exploration, and 3 condemnation drilling). Drilling included 160 000 m of resource delineation in the main grid designed to: 1) define the ultimate limits of the resource; 2) infill and upgrade the resource to Measured and Indicated categories for a Feasibility Study; 3) drill for a potential high-grade feeder at depth; and 4) explore





**Figure 1.12.** Distribution of mineral titles in the Nechako Plateau area surrounding the Blackwater project of New Gold Inc., current to July 2012 (source: Mineral Titles, Ministry of Energy and Mines). Location of Mt. Davidson is also shown.





**Figure 1.13. Blackwater project** – A. Blackwater project from above; B. Blackwater drill grid from above; C. New Gold geologists logging faulted andesite in hole BW-410; D. Bleached versus less altered lapilli tuff with garnet replacement of fragment (A. and B. photos by Lori Borth, North Area Resource Manager).

potential extensions to the deposit. A roughly 1.1 km<sup>2</sup> drill grid was established comprised of vertical holes averaging 450 m, and later angled holes to tie the grid together. An additional 40 000 m drilling was allocated to condemnation for proposed facilities sites; and exploration drilling at **Capoose** surpassed 10 000 m (see below). Drilling confirmed strong continuity of mineralization across the central and southeastern parts of the deposit, and extension to the north beyond the delineation grid, and northwest to a zone of higher grade silver along the outer portion of the grid. By July, a regional exploration program of reconnaissance mapping and geochemical sampling (glacial till and soil) was underway, and identified four new targets.

In September, New Gold announced completion of a PEA based on drilling up to mid-May, for a 60 000 t/d open-pit operation with annual production of 14 373 kg (507 000 oz) of gold and 57 805 kg (2 039 000 oz) of silver for an initial 15 years. Average gold production in the first five years would be higher at 16 896 kg (569 000 oz). The resource estimate is 267.1 Mt at 0.88 g/t Au and 4.3 g/t Ag, containing 213 190 kg (7.52 million oz) Au and 1.05 million kg (36.9 million oz) Ag

in the Indicated category; and an Inferred resource of 120.5 Mt at 0.69 g/t Au and 7.3 g/t Ag, containing 75 410 kg (2.66 million oz) Au and 802 290 kg (28.3 million oz) Ag at a 0.30 g/t AuEq cut-off. The life-of-mine stripping ratio would be 2.36:1. The processing plant would utilize conventional crushing, grinding, leaching and carbon-in-pulp to produce a gold-silver doré product. A Feasibility Study is scheduled for completion in 2013. The company envisions construction by early 2015, and ore extraction by 2017. A Project Description was submitted to the EA office on Oct 24, initiating the Pre-Application phase of the EA process. The economic benefit to the economies of Vanderhoof and Prince George is an estimated \$75 million during construction and \$25 million per year during mining. New Gold has about 85 employees at the site, plus another 160 contractors. The 150 person camp was expanded in 2012 to accommodate 230 people, and a local office and sample preparation lab was opened in Vanderhoof.

Paraphrasing a 2012 PDAC conference abstract by New Gold geologist Mark Peterson, the deposit is a low to intermediate sulfidation epithermal system, the intrusive source of which remains undiscovered.

Mineralization is hosted by late Cretaceous Kasalka Group rocks in a complex assemblage of andesite flows, lapilli tuffs, and volcanic breccias; flow-banded and tuffaceous rhyolites; a heterolithic breccia containing altered fragments of other units; and intensely silicified hydrothermal breccias. Alteration and mineralization are characterized by pervasive silica-sericite-illite accompanied by disseminated and stockwork veined pyrite-pyrrhotite  $\pm$  marcasite  $\pm$  sphalerite  $\pm$  galena  $\pm$  chalcopyrite  $\pm$  arsenopyrite  $\pm$  bismuthinite. Gold occurs as 25-50  $\mu$ m grains associated with sulfide and silicification. Multiple episodes of hydrofracturing and silicification are apparent. Local Mn-rich spessartine garnet replacement zones within the silicified volcanics are common in the western portion of the deposit. The currently delineated trend of mineralization strikes WNW-ESE and dips moderately north over an area measuring at least 1500 x 500 m, and to depths of more than 450 m. Elevated grades appear to be localized along the margins of silicified breccia bodies and at fault (broken rock zone) intersections. A minimum age of 67 Ma was determined from a felsic dike sampled from historic drill hole 92-35 (Friedman et al. 2001), and two K-Ar ages of 70.2 - 68.1 Ma on related rocks. The Blackwater wedge occupies a roughly 5 km square area and is juxtaposed against Ootsa Lake Group rocks across steeply-dipping normal faults on the west and north, implying the Blackwater block is a high-standing remnant or horst in the region, preserving what may be a Late Cretaceous rhyolite dome complex.

By September, 22 holes had been drilled at New Gold Inc's **Capoose** property. Early assay results showed Au-Ag mineralization both within and beyond previously defined boundaries for the resource. The property is underlain by Hazelton Group andesite flows, andesitic-dacitic tuffs, and argillite-siltstone intruded by quartz monzonite of the Capoose Batholith. Strongly silicified-sericitized, garnet-bearing fragmental rhyolite sills are the prime host of mineralization, and cut across hornfels at the upper contact of the batholith. The deposit covers an 850 x 1000 m area, is elongated north-south parallel to stratigraphy, and appears to dip moderately to steeply to the west. Mineralization occurs as pyrite-sphalerite-galena-chalcopyrite-arsenopyrite disseminations, aggregates and veinlets. Silver Quest Resources Ltd provided a resource estimate in 2010.

In January, Independence Gold Corp provided an updated resource estimate for the **3Ts** project, 18 km southwest of Mt. Davidson. The new estimate used an expanded database of 176 drill holes (32 773 m) incorporating 3278 assays from 2011. The cut-off grade was lowered from previous estimates to 1.0 g/t Au. The total Inferred estimate for the Tommy, Ted, and Mint veins combined is 3.61 Mt at 3.39 g/t Au and 85.15 g/t Ag, containing 11 181 kg (394 383 oz) Au and 280 380 kg (9.89 million oz) Ag. A mapping, prospecting and float sampling program during the summer was followed by drilling to test the Ted and Mint veins down-dip and

along strike beneath a cross-cutting microdiorite sill, as well as a Mint Vein northern extension. The 3Ts project covers an epithermal quartz-carbonate vein system with more than a dozen mineralized veins, ranging up to 650 m in length and 20 m true width. Additional vein discovery potential is indicated by mineralized float boulders in the Ringer area and other parts of the property. Independence Gold was formed as a spin-off from the New Gold Inc acquisition of Silver Quest Resources Ltd in late 2011.

In June, RJK Explorations Ltd completed their phase one drilling program at **Blackwater East** and **Northeast**, 14 km northeast of Mt. Davidson. Drilling tested five widely-spaced initial targets derived from the 2011 exploration program. Poor drilling conditions were encountered but two drill holes intersected pyritic intervals with 2710 g/t Ag over 3.3 m and 38.9 g/t Ag over 6.62 m. Follow-up structural interpretation, detailed ground magnetics, IP surveying and MMI soil sampling was completed in the area. Results suggest mineralization is at the brecciated fault contact between felsic volcanics and sediments to the northeast, and that a prominent northwest trending feature may represent an extension of the fault contact. The company also resumed grassroots work at **Blackwater West** and **Dave 2**, located 15 km southwest of Mt. Davidson, and identified four initial drill targets.

On the **Trout** property, 60 km southwest of Vanderhoof, Venerable Ventures Ltd completed an IP survey, sampled previously uncut drill core, and collected rock chip samples from eight backhoe trenches around and along strike of the Discovery Zone Au-Ag showing. A drilling program in September followed up on three of seven priority targets that were generated through airborne magnetic, IP geophysical surveys, and ultra-trace geochemistry designed to see through 20 - 40 m of basalt cover. The company believes the Discovery and Camp zone showings occur within a northwest trending, fault-bound graben structure. The remaining four targets saw additional grassroots work.

Parlane Resource Corp completed an IP and magnetic survey, and additional geochemical sampling over nine gold-in-soil anomalous target areas at **Big Bear**, 19 km northwest of Mt. Davidson. Four of the nine zones (Chedakuz, Chedakuz South, Top Lake South, and Top Lake North) show moderate to high chargeability, with moderate resistivity. The property has limited outcrop, but is reportedly centered on a 2.5 km diameter aeromagnetic high anomaly situated between the mineralized Blackwater and Capoose systems. A drilling program commenced in November to test five target areas.

In late 2011, Northern Vertex Mining Corp in joint venture with Kootenay Silver Inc initiated a Phase-2 drilling program at **Copley**, 60 km southwest of Vanderhoof, to test the Smoking Pipe target. Ten of 12 holes intersected a 150 x 100 m near-surface mineralized zone that dips to the west, and remains open in three directions. Step-out drilling encountered hydrothermal



breccias. Previous exploration on the property has suggested a large 7 x 2 km low-sulfidation epithermal system. Silicified and argillized rhyolite, in three aligned topographic domes, hosts near-surface Au mineralization with disseminated and vein pyrite and anomalous zinc and mercury.

Amarc Resources Ltd (affiliated with Hunter Dickenson Inc) conducted an IP survey at its **Galileo** project, a 990 km<sup>2</sup> land package extending from 16 to 50 km southwest of Mt. Davidson in what the company refers to as the emergent **Blackwater-Newton gold belt**. The program focused on new mineral claims added to the southeast side of the main block, south and east of Independence Gold Corp's 3Ts project, and followed up an airborne magnetic survey that identified two deposit-scale potential intrusive targets. Soil geochemistry done in the area had no significantly anomalous results. Within the main tenured block, a mapping and sampling program covered five target areas defined by ground geophysical surveys in 2011 that could represent either epithermal Au-Ag or porphyry Cu-Au systems. Exploration at **Hubble**, 66 km southwest of Vanderhoof, consisted of mapping, geochemical sampling, an airborne geophysical survey flown over newly added mineral claims, and 3 drill holes to test a 3 km<sup>2</sup> chargeability anomaly derived from a 2011 IP survey. Pyrite-bearing sandstone and mudstone with graphitic intervals were encountered.

Strategic Metals Ltd ran drill programs on **Tagai** and **Zakco** located 34 km south of Fraser Lake and 56 km south of Vanderhoof, respectively. Reverse circulation drilling on both properties tested geochemical and geophysical anomalies associated with porphyry Cu-Au (Tagai) and epithermal Au-Ag (Zakco) targets.

Troymet Exploration Corp's program at **Key**, 8 km southwest of Mt. Davidson, included prospecting and sampling early in the year followed by an IP survey and RC drilling in October. The IP survey covered six target zones in the East Central area with the Buzz, SGN and Blue zones selected as priority for drill testing as coincident gold-in-soil anomalies, and the P1A target in the West Central area. Ten holes were drilled at Buzz, and 2 holes were drilled in each of the remaining three targets. Active logging prevented access to other target zones near the East Fault. A May 2012 technical report describes potential for Mo-Cu porphyry (East Central and West Central zones), epithermal Au-Ag (proximity to Blackwater and 3Ts), and VMS (Ram claims on Tsacha Mountain) deposit types.

In June, Copper Creek Gold Corp entered into an option agreement with Stina Resources Ltd on its **Bandit** property, 30 km east of Mt. Davidson. In September, a percussion drilling program in 15 widely-spaced holes followed up MMI soil-sampling that delineated a 2 x 5 km Cu-Ag-Au ± Mo anomaly coincident with a magnetic low. Anomalous, but sub-economic Cu-Au-Ag was intercepted, and 8 of 15 holes ended in basalt cover that is over 100 m thick in areas.

In August, Redhill Resources Corp entered into option agreements with Decade Resources Ltd and Mountain Boy Minerals for **North Blackwater** and **East Blackwater**, and with private individuals for the **Chutanli** and **Aspen** properties. The company now designates the combined properties as **Aspen East** and **Aspen West**, located on either side of TTM Resources' Chu property 78 km southwest of Vanderhoof. A reconnaissance geochemical program identified three new targets. A ground IP survey is planned for late in the year to cover four target areas (3 in Aspen east, and one in Aspen west), including the historic CH (April) polymetallic sulfide vein.

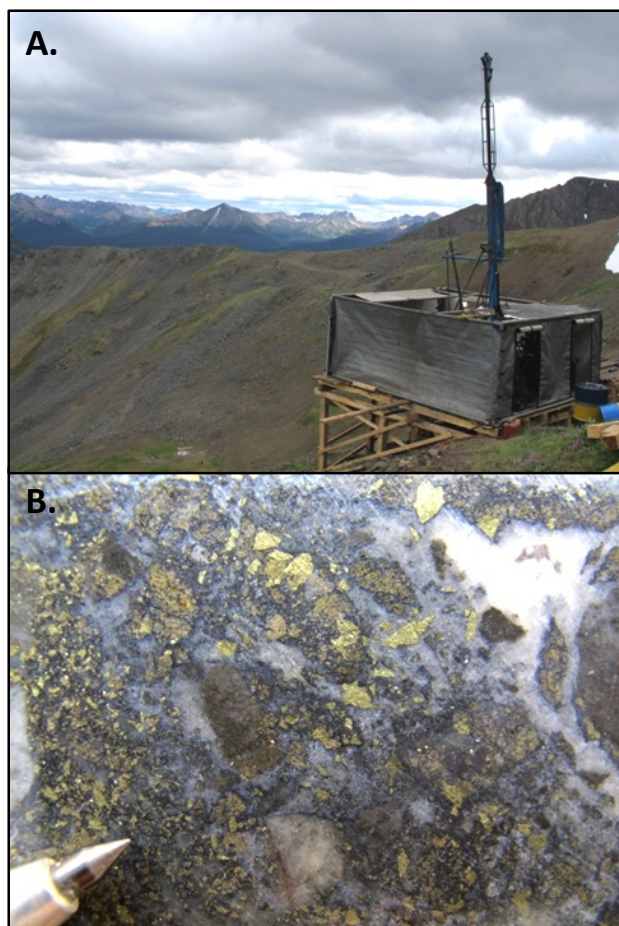
Driven Capital Corp completed an IP and magnetic survey on the southeastern portion of **Blackwater East (Kuyakuz Mtn)**, 25 km east of Mt. Davidson. The company found several IP anomalies trending north and northwest adjacent to a major regional lineament. The north trending anomaly has been traced over 1800 m near the western boundary of a locally silicified and phyllic-altered felsic volcanic sequence that is underlain by a deep 2 km wide magnetic feature. Previously completed soil sampling showed anomalous zinc-lead-silver-gold, and copper in the area.

#### *1.4.2.2 Cache Creek Terrane*

A private company, 0902744 B.C. Ltd., carried out prospecting and an airborne geophysical survey at **Green Gold**, 34 km west of Prince George. The discovery trench excavated in late 2011 exposed a clay zone containing quartz fragments and disaggregated stockwork. Nearby to the south, Porpoise Bay Minerals Ltd flew an EM and magnetic survey over the **PG** project, and excavated five shallow trenches over gold-in-soil and till anomalies. Overburden was too deep to reach bedrock. Both the Green Gold and PG properties are till-covered gold prospects near the Pinchi fault at the Cache Creek-Quesnel terrane boundary. Outcrops of quartz-carbonate-sericite altered rocks and listwanite have been observed.

#### *1.4.2.3 Toadoggone Region*

On its **JD** project, 54 km northwest of Kemess South, Tower Resources Ltd drilled 18 holes in and around the Finn Zone intercepting near-surface Au-Ag mineralized intervals up to 31.5 m in width and 0.40 - 32.95 g/t AuEq (Figure 1.14). The goal of the drill program was to confirm historic drilling with a 10-hole fence in a sequence of five drill pads spaced 30 m apart, with two scissored drill holes per pad; and to extend the potentially continuous tabular mineralized body westward over the ridge to historic trenching. A single exploration hole tested the eastern extent and footwall of the Finn zone, and two holes on the west side of the ridge were positioned in gold-in-soil anomalies near historic trenches and the



**Figure 1.14. JD project – A.** Drilling in the Finn zone, hole JD-12-10; **B.** Calcite-quartz cemented breccia with chalcopyrite-pyrite-galena-sphalerite, hole JD-12-005, 46.9 m.

projected trace of the controlling structure. Mineralized intervals resulted in both areas. The Finn zone sits in an east-facing cirque above a flat-lying controlling feature that could be a reverse fault or unconformity. In addition to drilling, B-horizon soil samples were taken over a 1.0 by 1.8 km area in the Finn and Creek zones, four times the size of historic soil grids on the property.

The northeast striking and gently dipping Finn Zone is hosted in an apparent polymict volcanic breccia unit. The hanging wall and footwall to the zone consist of massive and locally porphyritic andesite, latite, and crystal tuff of the Lower Jurassic Toodoggone Formation (Metsantan Member). Spahlerite-galena-pyrite ± chalcopyrite mineralization is hosted in quartz-calcite veins and cemented breccias with silicification and phyllosilicate alteration.

#### 1.4.2.4 Ancestral North America

At the **Mugaha** project, 15 km northeast of Mackenzie on Mount Morfee, QMC Quantum Minerals Corp conducted a shallow trenching program to

investigate 25 previously defined gold-in-soil anomalies. Fifteen trenches were dug by a heli-portable mini-backhoe, sampled and mapped. The property hosts mineralized quartz veins and veinlets in weakly metamorphosed and sheared Upper Proterozoic Misinchinka Group slate and siltstone.

Brocade Metals Corp conducted a short drill program at **Ruby**, 158 km northwest of Mackenzie, to determine if the Main showing continues at depth. The property is underlain by impure quartzite and quartz-mica schist of the Upper Proterozoic Swannell Formation (Ingenika Group) cut by Early Tertiary stocks and dikes (granophyre and quartz-feldspar porphyry). The Main showing occurs in a structurally complex area of folding, shearing and faulting, with multiple crosscutting sets of quartz-rich veins. A north-northeast trending polymetallic vein set contains pyrrargyrite ( $\text{Ag}_3\text{SbS}_3$ ), tetrahedrite, and native silver. Vein breccias, quartz stockwork, and silicification are closely associated.

Angel Jade Mines Ltd continued trenching, sampling and mapping across five properties in the **Manson Creek Group**, 75-100 km west and northwest of Mackenzie, in a well-established placer gold area that follows the Manson Fault zone. Approximately 200 small pits exposing bedrock have been excavated.

### 1.4.3 Volcanogenic Massive Sulfide (VMS) and Sedimentary Exhalative (SEDEX) projects

#### 1.4.3.1 Cache Creek Terrane

Using a technological database developed by Amarc Resources Ltd from 2007 - 2009, Rokmaster Resources Corp identified five coincident geochemical-geophysical targets for Kutcho-style VMS mineralization at **Bodine North**, 207 km northwest of Fort St. James. The property is underlain by Permo-Triassic bimodal volcanic and sedimentary rocks of the Sitlika assemblage that are considered to be the faulted southern extension of the Kutcho Creek Formation, which hosts the Kutcho Creek Cu-Zn VMS deposit 275 km to the north. The north-northwest trending, tight-to-moderately folded and faulted Sitlika rocks are situated between the Stikine and Cache Creek terranes.

#### 1.4.3.2 Ancestral North America

In May, Canada Zinc Metals Corp (CZM) provided an updated resource estimate for the Cardiac Creek deposit, a zone of baritic zinc-lead-silver SEDEX mineralization within its **Akie** property, 250 km north-northwest of Mackenzie in the Kechika Trough (Figure

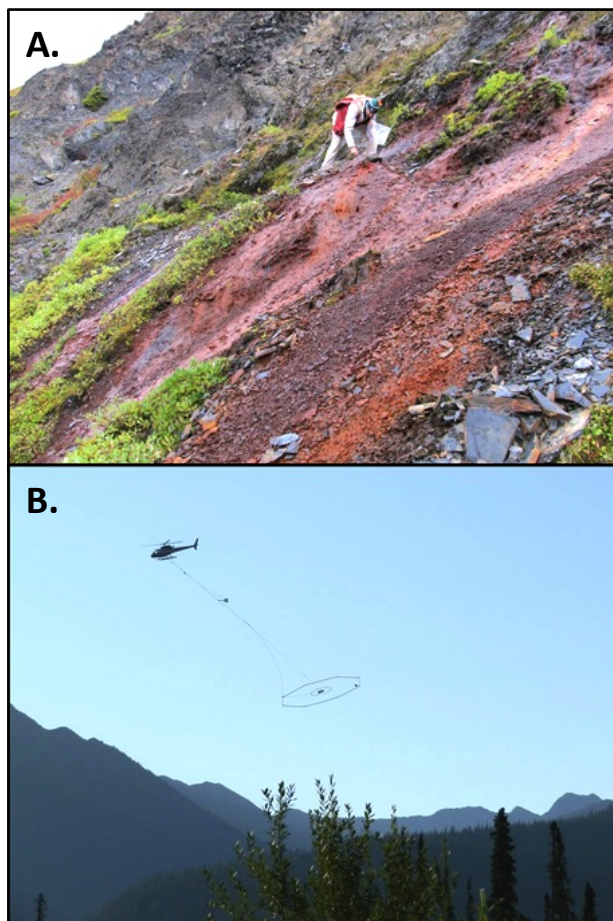
1.15). The report incorporated drilling from mid-2008 to end-2011 at a 5% zinc cut-off resulting in a resource of

- 12.7 Mt at 8.4% Zn, 1.7% Pb and 13.7 g/t Ag (Indicated);
- 16.3 Mt at 7.4% Zn, 1.3% Pb and 11.6 g/t Ag (Inferred);
- containing an Indicated 1.1 billion kg (2.4 billion lbs) of zinc, 214 million kg (472 million lbs) of lead and 158 760 kg (5.6 million oz) of silver;
- and an Inferred 1.2 billion kg (2.6 billion lbs) of zinc, 219 million kg (482 million lbs) of lead and 172 930 kg (6.1 million oz) of silver.

This represents a 23% tonnage increase from the 2008 estimate, and a 44% upgrade into the Indicated category. The deposit is open in all directions, with the potentially economic portion extending over 1300 m of strike length, at least 800 m below surface, and averaging 20 m in thickness. The company intends to complete the construction of a portal site and waste rock dump in preparation of underground exploration. Environmental baseline studies are ongoing.

Earlier in the year, CZM provided technical reports for the **Pie** and **Mt Alcock** properties, 12 and 45 km northwest of the Cardiac Creek deposit, summarizing mapping, prospecting, and geochemical survey results from 2011. This included anomalous Zn-Ag  $\pm$  Pb values in the West Pie panel extending for 8 km along strike and ranging between 100-750 m width; anomalous Zn  $\pm$  Ag values at the Creek 1 and Creek 2 showings; anomalous Ag  $\pm$  Zn in the East Pie panel extending over 1.2 km of strike and 250 m width; two parallel Zn-Ag  $\pm$  Pb anomalies along the Nod-Seep panel extending up to 3 km of strike, anomalous Zn-Ag  $\pm$  Pb southeast of the Seep grid, and a new target southwest of the Main barite showing. The 2012 southern **Kechika Regional** exploration program followed up on these results with additional mapping and geochemistry at Pie and Mt. Alcock to improve drill target definition. Additionally, the success of a hydrogeochemical survey technique tested in 2011 that provides real-time results for visually measuring elevated sulphate downstream of baritic mineral occurrences warranted further application as a sampling tool. Over 120 additional samples were taken across the Akie, Pie, and Mt. Alcock properties with anomalous levels showing in the northern portion of Central Pie, West Pie, and Mt. Alcock. Furthermore, to obtain lithological and structural information near surface and at depth, an airborne VTEM survey was flown over the properties at 200 m line spacing, and 100 m line spacing over the Cardiac Creek deposit and West Pie target area. The company plans to develop a SEDEX EM fingerprint that it can use elsewhere in the Kechika Trough.

The Kechika Trough is an elongate southern extension of the Paleozoic Selwyn Basin of the Yukon



**Figure 1.15. Akie project – A.** Collecting a geochemical sample; **B.** Airborne geophysical survey being flown (photos courtesy of Canada Zinc Metals Corp).

and Northwest Territories, a prolific sedimentary basin for Ordovician to Early Devonian SEDEX deposits. The **Akie** and **Kechika Regional** projects together comprise mineral claims extending over 135 km following northwest trending carbonaceous shale of the Gunsteel Formation in the Devonian-Mississippian Earn Group. CZM has subdivided the Kechika Regional project into 10 major blocks from northwest to southeast: Thro, Saint, Driftpile South, Bear/Spa, Weiss, Kwad, Mt. Alcock, Yuen, Cirque East and Pie. Digital compilation of historical exploration work is underway on all properties.

## 1.4.4 Ultramafic-hosted Projects

### 1.4.4.1 Cache Creek Terrane

In April, First Point Minerals Corp provided a resource estimate for the Baptiste deposit at its **Decar** nickel alloy project, 88 km northwest of Fort St. James on the southern flank of Mt. Sydney Williams (Figure 1.16). The project is under option to Cliffs Natural Resources Exploration Canada Inc, an affiliate of Cliffs Natural





**Figure 1.16. Decar project** – **A.** Caracle Creek geologist Mark Rein on Mt. Sidney Williams; **B.** Foliation in serpentinite at surface (326-328°, subvertical) in NW Baptiste area; **C.** Working in the core shack; **D.** pseudo-breccia texture of serpentinite in hole 12-BAP-041. This texture (and serpentinization/mineralization) may be structurally controlled by foliation exhibited in B.; **E.** Serpentinite speckled with awaruite grading 0.136% DTR Ni in hole 12-BAP-041, 215 m.

Resources Inc (CNR), a Cleveland-based international mining company and a major global iron ore and metallurgical coal producer. In the Inferred category, the estimate of 1197 Mt averaging 0.113% Ni contains 1.35 Mt of Davis Tube Recoverable nickel at a 0.06% Ni cut-off grade. This was derived from 42 holes (12 565 m) drilled on 200-metre centers by Caracle Creek International Consulting Inc, who is supervising and managing the exploration program on behalf of CNR. The Davis Tube method is an industry standard geometallurgical test for magnetic recovery operations.

The 2012 exploration program started in June in order to: upgrade the Inferred resource to the Indicated category; extend the limits of higher-grade zones (grading about 0.15% Ni) by stepping out in the south-central and northwest areas; and drill some step-out holes on the northern boundary to explore the deposit limits. Three drill rigs (two track-mounted and one heli-supported) were turning by August, and 27 angled holes were drilled along 100-200 m centers to 600 m down-hole depth, twice the depth of previous drilling. Results extended near surface mineralization in south-central area for 380 m to

the southeast, and further defined the east-west trending higher-grade zone at 650 m by 315 - 625 m and up to 460 m depth. Eight holes for hydrological monitoring wells were also drilled. Geotechnical analysis and point-load testing was done on four hydrological holes and four resource holes. Environmental baseline studies continued, as did further metallurgical test work on a 250 tonne bulk sample collected in 2011. A PEA is underway with completion expected for March 2013. The deposit represents a potential bulk-tonnage, open-pit operable resource with minimal acid-generating potential. Initial metallurgical testing shows the Ni-Fe alloy 'awaruite' ( $\text{Ni}_3\text{Fe}$ ) is recoverable using conventional two-stage grinding and magnetic separation, and does not require chemical processing. The deposit is located less than 5 km from an active branch of the CN Railway and within 110 km of the hydro power grid. Nickel is primarily used in stainless and alloy steel production.

The **Decar** property occurs in the Late Pennsylvanian to Late Triassic Trembleur Ultramafite, representing the upper mantle and lower crustal portions of an ophiolite sequence in the oceanic Cache Creek terrane. Two



northwest-trending metavolcanic panels are in fault contact with the peridotite. Two broad northwest-trending zones of mineralization occur on the property, and within these are four zones of relatively coarse (50 - 500 µm) disseminated awaruite referred to as the Sydney, Baptiste, Target B, and Van targets. The Baptiste deposit model consists of a 2.3 km long, curved sub-vertical volume of Ni-mineralized foliated and serpentinized peridotite. Mineralization is continuous over the volume, particularly in the west and central parts. The deposit remains open along strike, in the central south area, and at depth. It is bound on the southwest by a northwest-trending subvertical fault. The orebody is cut by several non-mineralized gabbro dikes ranging from 2-15 m thickness. Overburden ranges from 2 m to over 30 m depth.

First Point Minerals Corp drilled five holes at **Klow**, 137 km northwest of Fort St. James, to test a 530 m long northwest trending corridor within the 950 x 270 m main zone that shows elevated nickel-alloy values in surface sampling. Grade appears to increase to the north where drilling encountered 316 m averaging 0.1% Ni-in-alloy starting below 10 m of overburden. A ground magnetic survey for target development preceded the drilling. Serpentinized and deformed host rock with disseminated awaruite (50 - 600 µm), up to 4.9% magnetite, and 0.13% chromium, is similar to Decar. Association of awaruite with high tenor Ni-sulfides, pentlandite, heazlewoodite, and millerite has been previously reported.

Early in the year, Stratton Resources Inc collected 35 rock chip samples at **MAC** from an area 1.5 km northwest of the Pond zone that is underlain by an 11 km long cross-faulted northwest extension of the Trembleur Ultramafic Unit, similar to the serpentinite that hosts the Baptiste deposit 14 km to the east. Awaruite was identified in hand sample, with grains up to 500 µm. Davis-tube separated fractions of seven samples range from 0.25% to 0.64% Ni alloyed with iron and chromium. Additional mapping was planned.

Fort St James Nickel Corp completed a 6-hole drilling program in late 2011 at **Km 26**, 50 km north of Fort St. James, to test a 1400 x 400 m target area within a broad magnetic high. All holes encountered Ni-mineralized serpentinite, which only occurs at surface as float. Follow-up electron microprobe scans on 22 rubble samples showed mineralization is high-tenor Ni-sulfides but variable nickel-alloy is also present. Drill core and financial assistance was provided to the Department of Materials Testing at UBC where research is being conducted on the economic viability of extracting nickel from low-grade ultramafic complexes in BC. The property is underlain by Pennsylvanian to Triassic Cache Creek Group rocks (accretionary wedge and ophiolite) separated from Takla Group mafic tuffs and epiclastics by the Pinchi Fault Zone.

## 1.4.5 Specialty Metal Projects

### 1.4.5.1 Ancestral North America

In March, Taseko Mines Ltd provided a resource upgrade for the **Aley** niobium project, 130 km north of Mackenzie, with 286 Mt averaging 0.37% Nb<sub>2</sub>O<sub>5</sub> (containing 739 million kg of niobium) in the Measured and Indicated category; and 144 Mt averaging 0.32% Nb<sub>2</sub>O<sub>5</sub> (containing 323 million kg of niobium) in the Inferred (Figure 1.17). This represented a 170% increase



**Figure 1.17. Aley project – A.** Taseko Mines geologist Mercedes Rich at the carbonatite contact in the Saddle zone with syenite-bearing fenite breccia; **B.** Niobium ore in dolomitized carbonatite.

from the 2011 Inferred resource estimate and afforded Aley the claim of being the largest undeveloped niobium project in the world. With the updated resource able to support 25 years of operation, the company focused on advancing preliminary engineering and site planning for Feasibility, and continuing environmental baseline studies. Geomechanical drilling in the Central zone was designed to further develop a structural model, and geotechnical-condemnation drilling in the Foundex valley tested foundations for a potential tailings site, and Seepage Collection Pond facility. Early in the year, a metallurgical bulk sample was collected, and was followed by more detailed mineralogical studies to delineate ore-type domains within the Central zone. An amphibole characterization study to ascertain the distribution of undolomitized amphibole and its potential for asbestos-like mechanics was also conducted. The company anticipates completion of a Feasibility Study by early 2013 for a long-life, low-cost mining operation. Niobium is used in the manufacture of high strength, corrosion-resistant, low alloy steels (HSLA) specifically used in green technologies, turbines, aerospace, automobiles, oil and gas. Ferro-niobium (FeNb) prices fell modestly from about \$44-45 per kg in 2011 to \$40 per kg in 2012. There are only three major producers of FeNb worldwide accounting for about 99% of total reported production: two Brazilian companies and IAMGOLD which operates the Québec-based Niobec underground mine.

The Aley Carbonatite Complex is an ovoid 3-3.5 km diameter intrusion emplaced in Cambrio-Ordovician sediments of the Northern Rocky Mountain fold and thrust belt, close to the Late Proterozoic rifted margin of ancestral North America. The carbonatite has been divided into a 50 - 200 m deep zone containing magnetite-apatite-baddeleyite ( $\text{ZrO}_2$ ) bands, aggregates, and disseminations that are niobium enriched, and a deeper sodic-calcic amphibole bearing zone to about 300 m depth. Niobium occurs in the minerals pyrochlore and columbite, and secondary fersmite. The intrusive has historically been divided into a rauhaugite (dolomitic carbonatite) core zone with local “sweats” of soivite (calcitic carbonatite), but petrographic work by the company suggests a post-ore dolomitization of primary soivite has occurred, leaving relict soivite domains. Syenite and albitite occur as xenoliths in carbonatite along the margins of the intrusion, and as sub-rounded, comminuted clasts in an amphibolitic fenitized breccia zone that mantles the intrusion. Offshooting carbonatite dikes interfinger with this mantling breccia. The deposit remains open at depth in the east and to the south.

In May, International Montoro Resources Inc received the results of an airborne magnetic and radiometric survey flown over the **Tacheeda Lake** project, 90 km north of Prince George. Four high-priority targets were developed with coincident anomalies prospective of syenite/carbonatite intrusives. The property is underlain by Lower Cambrian limestone and dolomite.

## 1.4.6 Coal Projects

### 1.4.6.1 Southern Groundhog Coalfield

Atrum Coal conducted a 15-hole initial drilling program at **Groundhog**, 235 km north of Smithers. Drilling tested an 83 km<sup>2</sup> area and intersected a cumulative coal average of 20 m over multiple seams. Individual coal intercepts of 1.4 - 8.2 m were encountered between 13 m and 400 m depth, with average drilling depth to 330 m. Consistent drill intercepts suggest continuity of coal units across the property. The program was designed to expand the resource from a central core area into northern and southern extensions. Over 800 samples are being tested for coal quality, and a PEA with product market assessment is planned for completion in early 2013. The resource is currently 57.1 Mt (Ind.), and 101.9 Mt (Inf.), but is expected to increase significantly upon addition of the new drilling results. The company hopes to develop an open-pit mineable resource for pulverized coal injection (PCI) metallurgical application.

The Southeast Groundhog coalfield falls within the Omineca Region boundary in the Skeena and Duti River watersheds west of Tatlatui Provincial Park, over an area of 30 x 80 km. Multiple coal seams of semi-anthracite to anthracite rank are hosted in Currier Formation mudstone, shale, and sandstone of the Upper Jurassic to Lower Cretaceous Bowser Lake Group. Historical work suggests coal-bearing sequences approach 1100 m in thickness with 33 identified coal units of up to 11.8 m in true thickness.

## 1.4.7 Industrial Mineral Projects

### 1.4.7.1 Cache Creek Terrane

Porpoise Bay Minerals Ltd conducted a 6-hole drilling program at the **Hoof** magnesium-nickel project, 20 km southeast of Vanderhoof on Sinkut Mountain (Figure 1.18). Anomalous nickel in weakly serpentinized (amphibole and talc-carbonate altered) peridotite averages 0.23-0.25% of which about 57% is in fine disseminated sulfide. A previous engineering study concluded magnesium at 24-26% is feasibly extractable using existing technology. Uses of magnesium in industry include alloying with aluminum (automotive industry), iron and steel production, and uranium production. The company plans to begin modelling the deposit. The property is underlain by a northwest trending remnant of the Cache Creek Group that has been thrust above the Early Permian to Late Triassic Vanderhoof Metamorphic Complex.





**Figure 1.18. Hoof project – A.** Outcrop of peridotite with Porpoise Bay Minerals' Rupert Seel in background with drill.

#### 1.4.7.2 Ancestral North America

In late 2011 Stikine Energy Corp released a PEA for the **Angus** frac sand project, 58 km northeast of Prince George. In the report, an open-pit mine is proposed with a 1 Mt/y production rate over a 25 year life of mine, and a mill throughput of 4570 t/d. The Inferred resource is estimated at 726 Mt of (meta)-sedimentary material. The mine plan specifies a series of nine pits that will be progressively mined and backfilled with tailings, avoiding the need for an external TSF. Autogenic crushing, attrition scrubbing, and density separation will be used in processing, without chemical treatment. The Angus deposit represents a nearby frac sand source to unconventional shale-gas plays in the Horn River and Montney Basins of northeast BC. Demand for frac sand in the Montney Basin is projected to be 1.4 Mt by 2014. As a proppant, frac sand has specific size, strength, sphericity, and SiO<sub>2</sub> purity requirements. The PEA uses base-case and alternate-case product values of \$200-\$250/tonne. The project is focused on quartzite and quartz arenite of Upper Proterozoic to Lower Paleozoic Misinchinka, Gog, and Boulder Creek Groups following the northwest trending Mount Averil ridge.

## 1.5 OUTLOOK FOR 2013

Several advanced projects and mines are expected to reach significant milestones in 2013 including commercial production at the **Mt. Milligan** mine; optimized milling with resumed mining at **Endako**; final developments towards mine construction at **Kemess Underground**; completion of a Feasibility Study for **Blackwater**; advancement toward Feasibility at the **Aley** niobium and **Angus** frac sand projects; and results of PEA studies at the **Decar**, **Kwanika**, and **Groundhog** projects. There is considerable mineral potential across the region in a variety of commodities and many attractive projects with potential for development given improved global economic circumstances and venture capital accessibility. Grassroots and early stage exploration may see an upsurge as the Mt. Milligan mine and Blackwater major projects further develop.

## ACKNOWLEDGMENTS

The information in this report has been sourced from news releases, company websites, technical reports, MINFILE reports, Geological Survey of British Columbia publications Bulletins, site visits and direct conversation with geologists, explorationists, and professionals who were generous with their time and resources. The writer thanks those who provided statistical and related information, and exchanged ideas, and the support of staff in the Prince George Regional Office. Additional thanks to the Regional Geologists and the Mineral Development Office for helpful support, including MDO Director Bruce Madu for reliable feedback and comment on this report, and Robin Chu for GIS support. Special thanks to Regional Geologist Jeff Kyba for accompaniment on field visits in the Nechako Plateau, and 2011 contract Regional Geologist John Degrace for initial job training and continued guidance throughout the year, including an insightful review of this report.

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# EXPLORATION AND MINING IN THE SKEENA REGION, BRITISH COLUMBIA

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## 2.1 SUMMARY AND TRENDS

Exploration and mining activity in the Skeena Region attained a record high level of expenditure in 2012. The apparent tighter fiscal times resulted in less immediate availability to high-risk capital and fewer implemented grassroots stage projects. However, the level of activity maintained by advanced stage exploration projects remained high. Finite exploration budgets have forced companies into exploring smarter, generating higher quality targets before the expense of drill testing; innovative techniques are getting increased mileage out of limited funding; and, of course, there are some less explored, high quality projects available for joint venture options.

At least 82 significant exploration projects (Map 2.1) were active in the region in 2012 and spent over \$285 million -nearly a 30% increase from 2011 (Figure 2.1). Approximately 90% of exploration expenditure was spent on advanced stage projects and the fifteen projects undergoing mine evaluation. The remaining 10% of expenditure was spent on grassroots, and early stage exploration; about half of what a healthy exploration pipeline should be to ensure steady graduation of projects from early stages. The limited number of active early stage projects is reflected in the 8% decrease in exploration drilling (Figure 2.2). Mine construction and development expenditure are estimated at over \$133 million. Expenditure on hydro power-related projects, including the Northwest Transmission Line, totalled over \$1 billion. This level of development spending is unprecedented and reflects the costs of constructing key infrastructure and will be the source of hundreds of long-term, well paying jobs for the northwest. It is also a confirmation that the region is an attractive jurisdiction for large capital projects which inherently increase development confidence for all levels of responsible mineral exploration.

2012 Significant events:

1. Brucejack – 41 bonanza grade (>1000 g/t) gold intercepts (Figure 2.3) from the Valley of the Kings; largest drilling program on the property to date and in the region at 105,769 m.
2. Strong (highest grade to date) porphyry Cu-Au mineralization intercepted at KSM
3. Mines Act Permit issued to Red Chris project, mine construction underway
4. Huckleberry Mine implements Main Zone Optimization plan, extends mine life to 2021
5. Northwest Transmission Line construction continues as well as associated hydro projects
6. Extensive Cu-Au-Mo-Ag porphyry mineralization drilled at Ootsa
7. Kitsault project enters EA process, decision due
8. Tulsequah Chief project receives EA amendment and positive feasibility study
9. Morrison project is denied EA certificate
10. Arctos Anthracite project (formerly Klappan) releases Definitive Feasibility Study
11. Porphyry Au-Cu mineralization identified at Castle Project
12. Large generative exploration programs being conducted by major mining companies

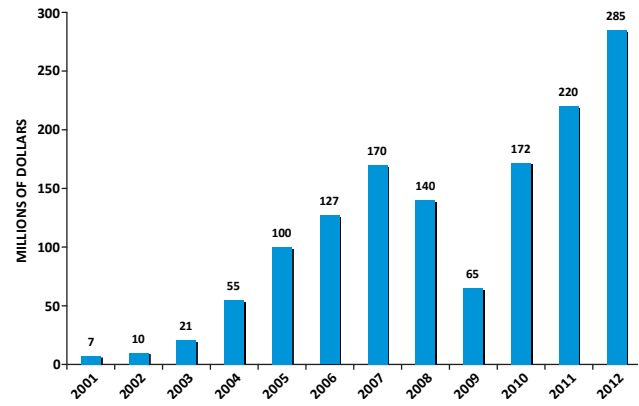


Figure 2.1. Annual exploration expenditure, Skeena Region.

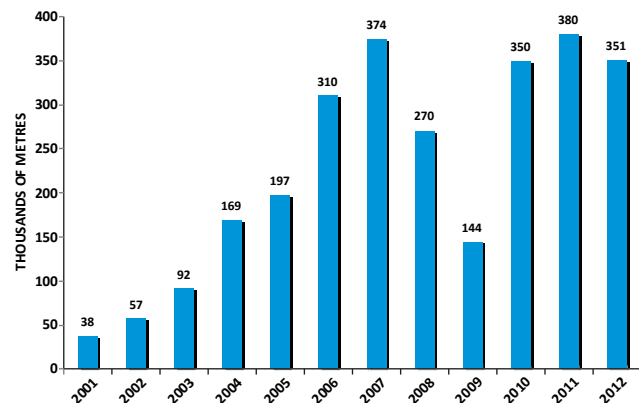
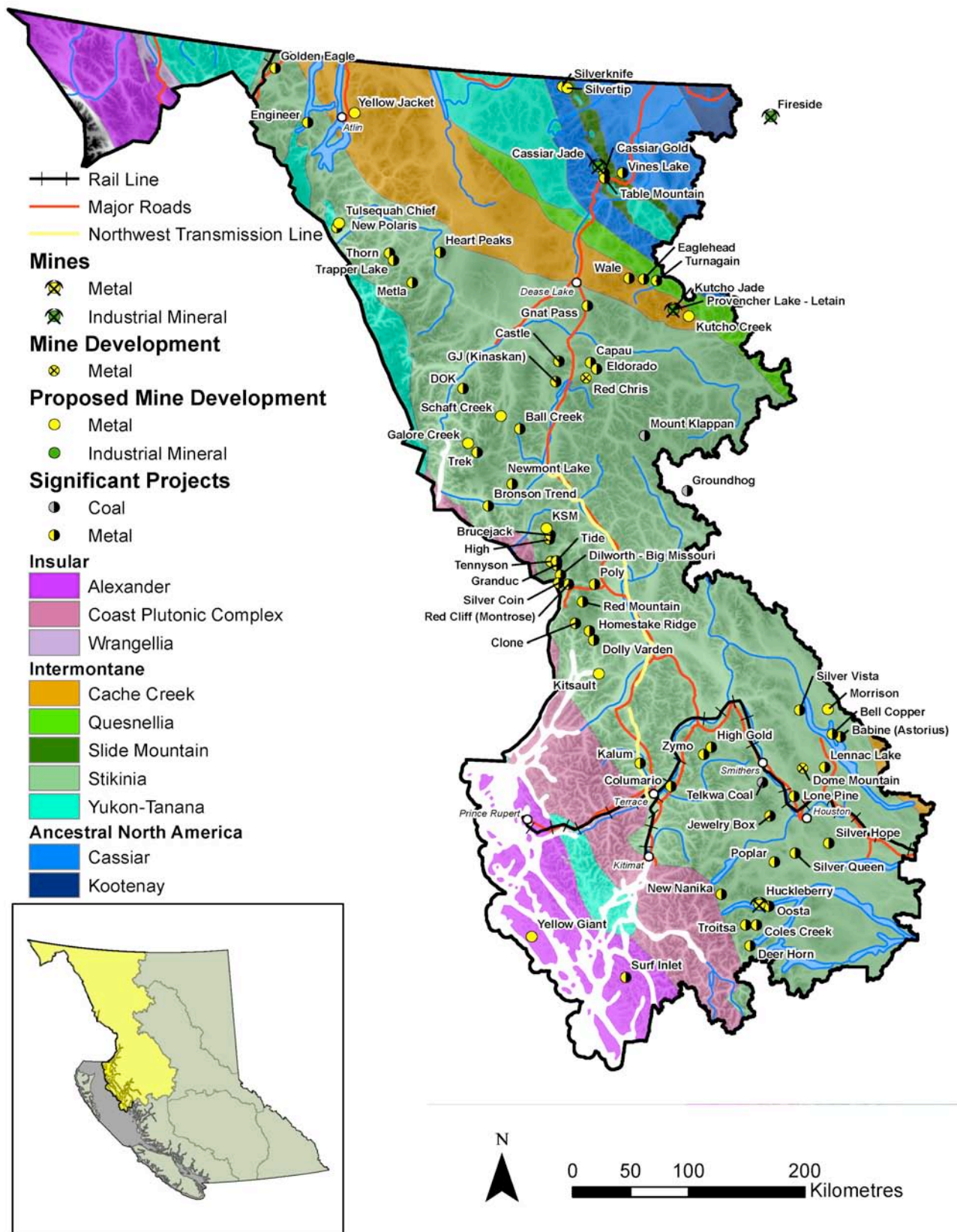


Figure 2.2. Annual exploration drilling, Skeena Region.





Map 2.1. Mines and Major Exploration Projects, Skeena Region, 2012.



Figure 2.3. High-grade gold from the Valley of the Kings zone at Pretivm's Brucejack project. This sample graded 41 582 g/t Au plus 27 725 g/t Ag across 0.5 m from 201.47 m in drill hole SU-452.

## 2.2 MINES AND QUARRIES

### 2.2.1 Major Metal Mines

#### 2.2.1.1 Huckleberry

The **Huckleberry** copper-gold-silver-molybdenum mine (MINFILE 93E 037) is located 123 km southwest of Houston BC and is operated by Huckleberry Mines Ltd (Table 2.1). Ownership is divided between Imperial Metals Corp (50%), Mitsubishi Materials Corporation (32%), Dowa Mining Co. Ltd (6%), Furakawa Company Ltd. (6%) and Marubeni Corporation (6%). 2011 metal production totalled 19 427 tonnes copper, 109.48 kilograms gold, 6785 kilograms silver, and 3.14 tonnes molybdenum from 5 929 700 tonnes of ore. Grades averaged 0.365% Cu and 0.007% Mo. Copper recovery was 89.9%. Forecast 2012 metal production is 14 968 tonnes copper, 77.75 kilograms gold and 4416 kilograms silver. A significant amount of material was sourced from low grade stock-piles resulting in expected decreased metal production. Additional ore was mined from the Main Zone Extension (MZX) pit amongst preparation activities associated with the Main Zone Optimization (MZO) mining plan. The MZO development creates a super pit by combining the current MZX pit with the original Main Zone Pit by removing the saddle between them and the tailings and waste rock fill as shown in Figure 2.4. MZO development activities have been a

primary focus of 2012 operations which include a high-wall push back of the MZX pit, stripping waste rock from the previous Main Zone Pit (Figure 2.5), expansion of the East Pit Tailings Dam and construction of a new Tailings Management Facility (TMF 3). Construction of TMF 3 is ahead of schedule by 3 m (927 m) elevation as of October when construction operations were suspended for the winter. The MZO was permitted and approved in January and extends the mine life from 2014 to 2021. MZO reserves excluding stockpiles total 39.7 Mt grading 0.343% Cu and 0.009% Mo at a 0.20% Cu cut-off grade.

Exploration activities included 9.8 line km of Titan-24 Induce Polarization (IP) adding to the 2011 survey and near mine exploration drilling. Three targets were drill tested: MZ Deep, Old Nag Quarry and NW MZO. Two drill holes totalling 1148m tested the MZ Deep target; a moderate chargeability / resistivity anomaly beneath the limits of known mineralization at the Main Zone. Drilling successfully identified significant copper-molybdenum porphyry mineralization with best intercept totalling 192.02 m grading 0.342% Cu and 0.006% Mo from 273.41 m in drill hole MZDP12-6. Mineralization identified in this area lends evidence of a possible continuous zone linking the East and Main Zone deposits. Eight drill holes totalling 2206 m tested the Old Nag Quarry target located immediately adjacent the planned MZO pit. Near surface low-grade (0.20-0.25%) copper mineralization was identified which is not currently in the mine plan. Drilling at the NW MZO totalling 5 holes tested IP anomalies but did not identify significant continuous mineralization.

TABLE 2.1. MINE PRODUCTION AND RESERVES, NORTHWEST REGION

Mine	Operator	Production (2011)	Tonnes milled (2011)	Reserves	Grade
Huckleberry	Huckleberry Mines Ltd.	19 427 tonnes copper 3.14 tonnes molybdenum 109.48 kg gold 6 785kg silver	5 929 700	39 700 000 tonnes @ 0.343% Cu, 0.009% Mo (Nov 22, 2011)	0.365% Cu, 0.007% Mo
Fireside	Fireside Minerals Ltd.	not available	24 000 ( in 2012) *approximate*	120 400 (not NI 43-101 compliant)	



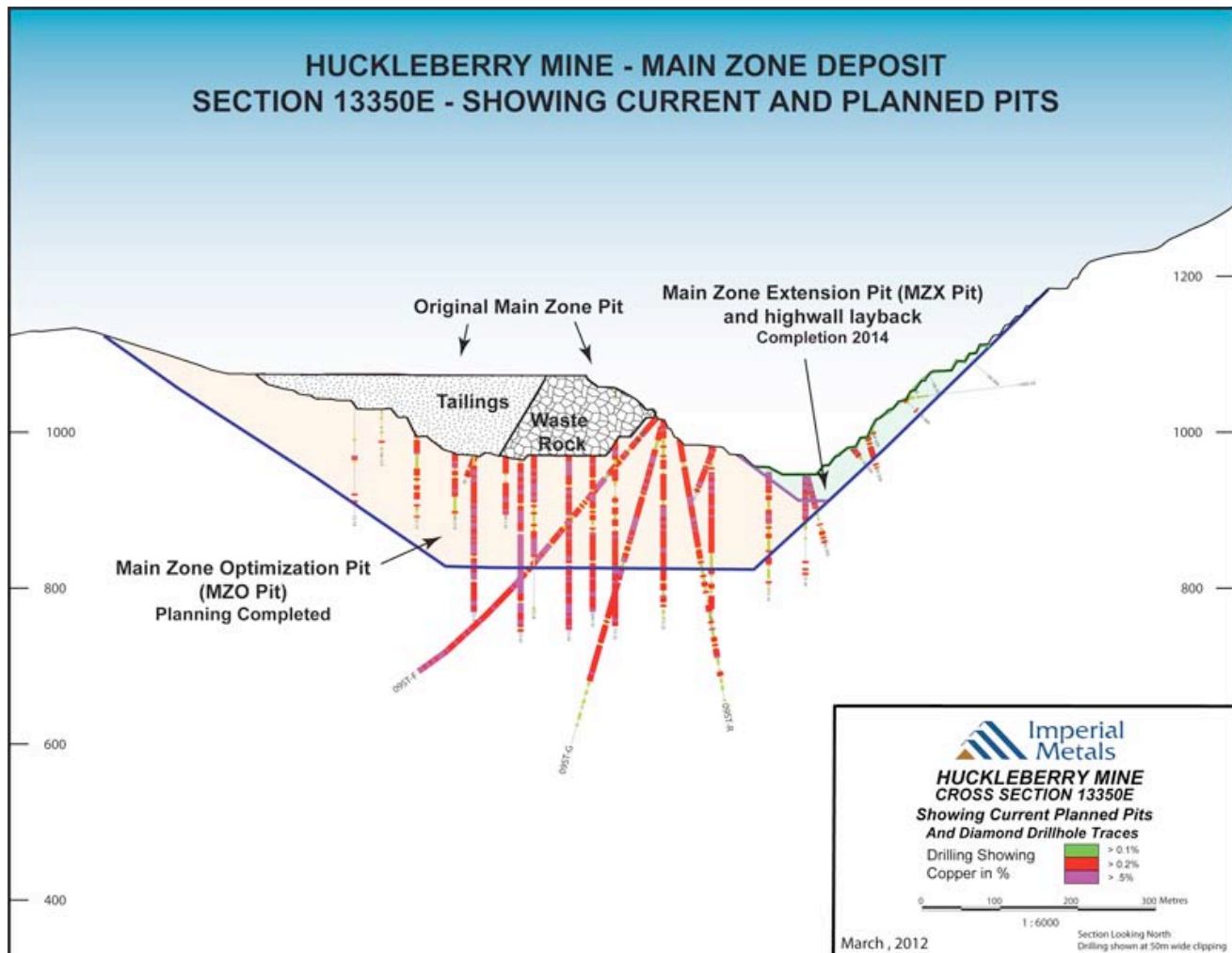


Figure 2.4. Updated Huckleberry Mine Main Zone Optimization cross-section with Cu bearing drill hole traces. Courtesy of Imperial Metals.



Figure 2.5. Overview of the Huckleberry Mine site looking southwest. Huckleberry Mines geologist Justin Schroff points out site components. Mill site is far left, stripping activities for the Main Zone Optimization are mid-left of center, active mining in the Main Zone Extension Pit is bottom center and mid-right of center.

Huckleberry is a porphyry copper deposit related to the late Cretaceous Bulkley intrusions. In the Main zone, copper mineralization occurs in hornfelsed and fractured Hazelton Group volcanic rocks adjacent to a 500 m diameter granodiorite stock. The arcuate ore zone is 150 to 200 m wide by 600 m long and rims the contact of the stock. The mined-out East zone was larger, measuring

150 m wide by one km long, and centred on a fault-controlled 40 m wide granodiorite dike that trends at 105°. Ore in both zones is a stockwork of quartz, pyrite and chalcopryite, crosscut by gypsum-filled fractures. The Main and East zones are disrupted by the 105 Fault resulting in ~100 m of dextral offset of ore. The Main Zone Extension is the faulted portion of the Main Zone north of the 105 Fault.



## 2.2.2 Quarries

### 2.2.2.1 Fireside

Fireside Minerals Ltd continued to mine barite from its summer-seasonal **Fireside** barite operation (MINFILE 94M 003) located 125 km east of Watson Lake (Table 2.1). Total barite production estimates were not available. Step-out reverse circulation drilling continues to identify barite mineralization however confidence is limited due to RC recovery. A newly re-fitted bagging plant shown in Figure 2.6 has been constructed at the mine site and began operations in July. Remaining barite was trucked to the company's bagging plant in Watson Lake. Bagged product is sold on site to various operators who utilize the drilling fluid additive in the oil and gas industry.

Steeply-dipping barite veins at Fireside are associated with a gabbro dike of inferred Paleozoic age emplaced into Kechika Group strata, possibly related to rifting of the early Paleozoic North American continental shelf (Wojdak, 2008).

Nephrite jade mining in northwestern BC continued seasonal operations in the Dease Lake area at four quarries: **Provencher Lake** (MINFILE 104I 073, 092), **Kutchó** (MINFILE 104I 078), **Cassiar** (MINFILE 104P 005) and **Dynasty** (MINFILE 104J 057). The Dynasty quarry is shown in Figure 2.7. Total production numbers of the gemstone are not available. Total jade sales are by private arrangement and range from small, highly polished pendants to multi-tonne rough boulders. Buyers of the raw boulders generally ship the stones off-shore for sculpting.

BC Jade is mined as a variety of placer as most boulders are not found in place. The exception is Dynasty where the jade is mined within an exposed shear zone of serpentinite. Nephrite jade is formed at the contact between tectonically-emplaced serpentinite and argillite of the Cache Creek terrane east of Dease Lake, and of the Slide Mountain terrane at Cassiar.

Industrial quarries in the Prince Rupert and Stewart areas provided material for major infrastructure upgrades at the Ridley Island terminal expansion (Figure 2.8), the port of Stewart and the Canadian National Railway between Terrace and Prince Rupert. The Ridley Island quarry produces amphibolite grade metasediments to be used at the port expansion. The **Tyee** quarry (MINFILE 103I 202) produces epidote bearing granite for dimension –stone. The **Kwinitsa** quarry (MINFILE 103I 011) produces silliminite grade geinss for CN rail-bed material and rip-rap stone used to protect Highway 16. At least one quarry in the Stewart area produced granitic material interpreted to be associated with construction activities at Stewart Bulk terminals.



Figure 2.6. Mine Inspectors Doug Flynn and Rebecca Misener take a closer look at the former flour bagging plant now re-fitted and reinforced for barite at the Fireside mine site



Figure 2.7. Nephrite jade lenses hosted in a serpentine shear zone at the Dynasty Jade quarry.



Figure 2.8. Expansion of the Ridley Island coal terminal is underway and receives fill material from nearby industrial quarries.

## 2.3 MINE DEVELOPMENT AND EVALUATION PROJECTS

### 2.3.1 Red Chris

The Red Chris Development Company Ltd, a wholly owned subsidiary of Imperial Metals Corporation, received their Mines Act Permit May 4th and began construction days after on their **Red Chris** (MINFILE 104H 005) copper-gold project located 80 km south of Dease Lake. Major infrastructure construction dominated 2012 activities with a goal of completion by early 2014. Milestones achieved this year include: the opening of a 487 person construction camp, excavation and pouring of some concrete for the process plant, road construction into the Tailings Impoundment Area (TIA), development of a gravel resource within the TIA to be used in concrete works and excavation for the mill site and truck shop. Detailed mine engineering continues with approximately 65% complete at year end. Long lead time equipment including the Semi-Autogenous-Grinding mill, ball mill and a primary crusher have been procured. The 30 000 tonne per day mill is scheduled to be commissioned in 2014 harmoniously with the completion of the Northwest Transmission Line.

Proven plus probable reserves remain at 301.549 Mt with an average grade of 0.359% Cu + 0.274 g/t Au. A technical report released in February included results from 62 diamond drill holes totalling over 69 thousand metres completed since May 2010 and is the first estimate to include a silver resource. Updated Measured plus indicated resources (inclusive of reserves) increased by 103% totalling 1218 Mt grading 0.327% Cu, 0.327 g/t Au and 1.114 g/t Ag using a 0.2% eCu cut-off grade. Additional inferred resources total 785 Mt grading 0.333% Cu, 0.347 g/t Au and 1.145 g/t Ag at a 0.2% eCu cut-off grade.

Exploration activities included five deep drill holes totalling 5415 m spread amongst the Gully, Saddle and East zones. Approximately 1 km southwest of the current pit design at the Gully zone, broad Cu-Au intercepts returned from late 2011 drilling were followed up by two deep drill holes (Figure 2.9). Mineralization style in the highest grade intervals of drill hole RC12-580 show similar breccia fragments, alteration and mineralization to the high-grade feeder system in the deep portions of the East Zone. These observations support current exploration models of a separate feeder system beneath the Gully zone. Exploration activities were suspended in May to maximise available resources for construction. Best drilling intercepts released in 2012 are summarized in Table 2.2

The Red Chris deposit comprises the adjoining Main, East and Saddle zones within a 204 Ma monzodiorite stock. The stock intrudes Stuhini Group volcanic rocks to

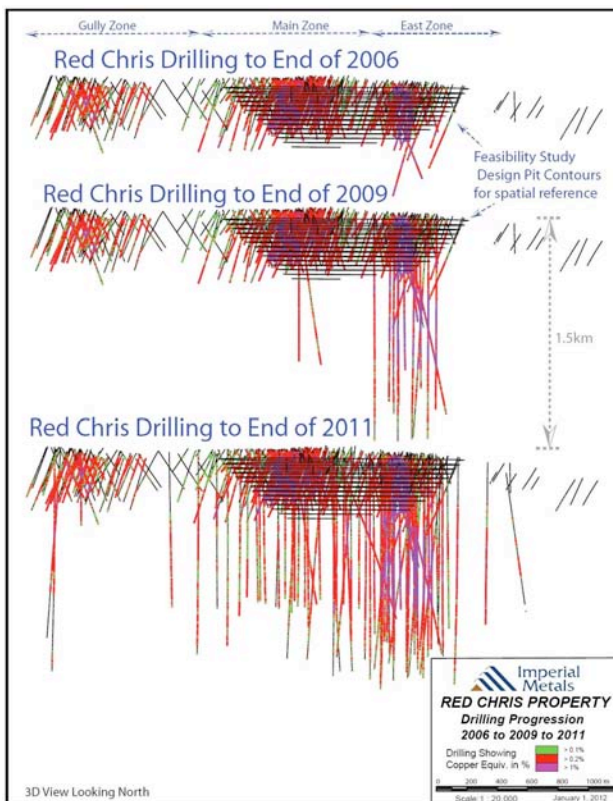


Figure 2.9. Red Chris deposit growth from 2006 to 2011. Courtesy of Imperial Metals.

the north and is overlain by, and faulted against, Bowser Lake Group sedimentary rocks to the south

The East zone (EZ) fault controls both the east-northeast trending Red stock and the most intense quartz vein development, which, in turn, corresponds with the best copper and gold grades. At depth in the porphyry system, alteration comprises K-feldspar, biotite, magnetite and anhydrite. Closer to surface within the planned open pit, alteration comprises sericite, pyrite, quartz, hematite, ferrodolomite and chlorite. The occurrence of volcanic rocks between the Main and East zones suggest the Red stock has at least two intrusive centres. Zoning of gold to copper ratio and interpretation of a deep penetrating IP survey suggest a third intrusive centre may lie west of the Main zone, beneath the Gully zone.

### 2.3.2 Northwest transmission line and hydro projects

Construction is well under way on the 344 km Northwest Transmission Line (NTL) that will provide 287 kilovolt service roughly half way up the center of northern British Columbia from Terrace to Bob Quinn Lake. BC Hydro awarded Valard Construction and Burns & McDonnell the design and build contract and began right-of-way and access clearing in January 2012.



**TABLE 2.2. RED CHRIS EXPLORATION DRILLING HIGHLIGHTS**

Drill Hole	Zone	Depth from (m)	Depth To (m)	Interval Length (m)	Copper %	Gold g/t	Silver g/t
<b>RC11-477</b>	Gully	172.5	980.0	807.5	0.31	0.29	1.61
<b>RC11-539</b>	Gully	275.4	862.5	587.1	0.41	0.41	2.05
<b>RC12-580</b>	Gully	335.0	940.8	605.8	0.39	0.43	2.00
<b>Incl</b>	Gully	495.0	542.5	47.5	1.00	1.06	3.87
<b>Incl</b>	Gully	627.5	722.5	95.0	0.77	0.73	2.69
<b>RC12-583</b>	Saddle	549.5	1057.5	508.0	0.24	0.22	0.58

Construction progress was visible (Figure 2.10) from highway 37 throughout the year and remains active in to the winter months with an estimated 280 people directly employed. The \$561 million project is the longest power line project in BC Hydro's capital plan and is scheduled to be in service by spring 2014. Several hydro power projects throughout the northwest are under construction to feed into the NTL. These include three projects in the Iskut River area owned by Alta Gas. The 195 MW Forest-Kerr run-of-river project is scheduled to be completed mid 2014, the McLymont Creek and Volcano projects are in pre-construction stages. The Long Lake hydro project is located approximately 25 km north of Stewart and owned by Regional Power Inc partnered with Premier Power Corporation. Long Lake will produce 31 MW and is scheduled to be completed by late 2012.

### 2.3.3 KSM (Kerr – Sulphurets-Mitchell)

Seabridge Gold Inc is preparing to submit an Environmental Assessment package by early 2013 for the **KSM** project is located 65 km north of Stewart. KSM is comprised of four defined deposits over roughly 10 km



Figure 2.10. Northwest Transmission Line right-of-way clearing and pole foundation near Bell 2.

strike length south to north: Kerr, Sulphurets, Mitchell and Iron Cap. Combined, these add up to one of the largest undeveloped gold-copper porphyry systems in North America with proven plus probable reserves totalling 2 164 Mt averaging 0.55 g/t Au, 0.21 % Cu, 2.74 g/t Ag and 44.7 ppm Mo. Measured plus indicated resources (inclusive of reserves) total 2 779.9 Mt grading 0.55 g/t Au, 0.21% Cu, 2.9 g/t Ag and 55 ppm Mo. Inferred resources total 1 127.2 Mt grading 0.41 g/t Au, 0.17% Cu, 3.0 g/t Ag and 50 ppm Mo. An updated preliminary feasibility study (PFS) released in May incorporated feedback from various stakeholders and resulted in multiple project improvements. 1) Combination open-pit and block-cave mining methods will be employed on the Mitchell deposit and underground panel caving in the Iron Cap deposit. These changes decrease the project strip ratio from 2.7 to 1.5 and eliminate 2.3 billion tonnes of waste rock stripping and storage. 2) Access route from highway 37 has been re-routed to reflect feedback from the Nisga'a Nation and First Nations. 3) Fine crushing and grinding facilities have been re-located to the Teigen site where primary crushed ore will be transported via conveyor through the Mitchell tunnel. 4) The Tailings facility will be built to best practice standards of the International Cyanide Management Code which includes lining of part the facility but not a current requirement under existing regulations. 5) Engineering for the tailings management facility and project water management has been completed to a Feasibility level. A proposed project layout map is shown in Figure 2.11

The KSM project is planned to operate over a 55 year mine life with an estimated capital cost of \$5.3 billion. The initial 25 years would be an open pit mining operation processing 130 000 tonnes per day (tpd) decreased to 90 000 tpd for the remaining 30 years. Ore would be fed to a floatation mill and produce a gold-copper-silver concentrate and then trucked to the Stewart port facility. Metallurgical testing indicates a salable, clean 25% copper concentrate can be produced. Separate molybdenum concentrate and gold-silver dore' would be produced at the KSM processing facility.



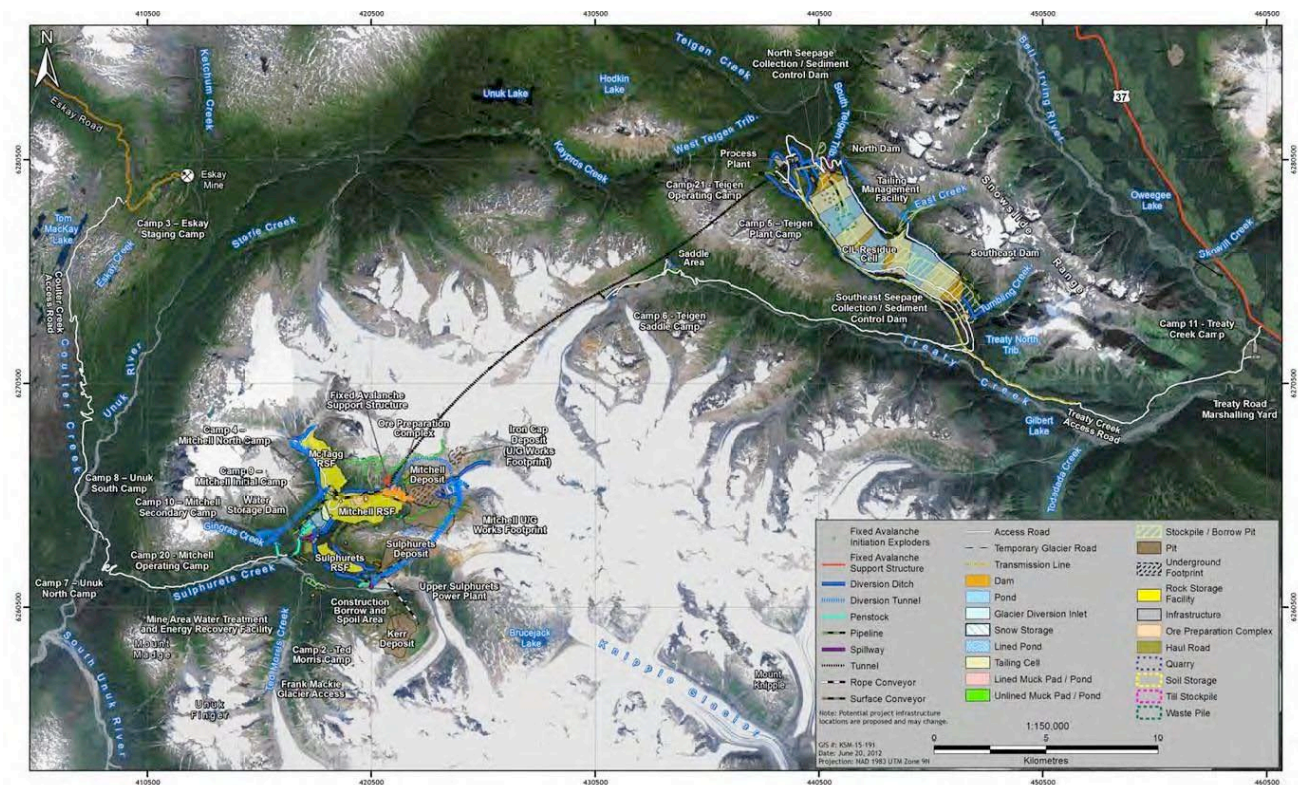


Figure 2.11. Proposed site layout of the KSM project. Courtesy of Seabridge gold.

2012 drilling comprised of exploration and geotechnical objectives totalling 23 442 m. Exploration targets were generated from magneto telluric (MT) geophysical surveys conducted in 2011 and used large porphyry deposit analogs such as Grasberg, Bingham Canyon and Oyu Tolgoi. Resistivity anomalies coupled with a high grade core zone hypothesis, open to depth deposit geometry and higher temperature mineral and alteration assemblage vectors led to successfully identifying higher grade copper-gold mineralization. The discovery of the Camp Zone located between the defined Kerr and Sulphurets deposits identified unanticipated epithermal-style, poly-metallic mineralization. Best intercept was returned from drill hole C-12-03: 98.7 m averaging 2.11 g/t Au plus 2.5 g/t Ag from 151.3 m. Multiple other targets at McQuillin, Deep Iron Cap and Mitchell North proved interesting and warrant follow up drilling but the possible game-changing Deep Kerr zone was drilled in late summer and will be aggressively followed up in 2013.

Drill hole K-12-21 located on the southern extent of the defined Kerr deposit returned 473.0 m grading 0.90% Cu and 0.31 g/t Au from 20 m. Two other holes testing Deep Kerr also returned significantly higher grades than currently in the Kerr Zone reserves (242 Mt grading 0.24 g/t Au, 0.45% Cu and 1.6 g/t Ag) indicating the Deep Kerr zone could add substantial metal value and a positive influence on overall project economics.

The KSM porphyry deposits are associated with the Mitchell intrusions; high level diorite to monzonite plugs and dikes that intrude folded and faulted volcanic and sedimentary rocks of the Hazelton and Stuhini groups. The principal Mitchell zone is exposed in an erosional window below the Mitchell thrust fault; the upper fault sheet contains the displaced segment of the deposit, the Snowfield zone, 2 km east on the adjoining property owned by Pretium Resources. The KSM deposits show broad metal zonation: high copper – low gold grades in the south at Kerr to the inverse at Mitchell and Iron Cap. The zonation could be evidence of higher temperature and greater system depth at Kerr to lower temperature and higher level emplacement at Mitchell. The Mitchell zone (Figure 2.12) comprises schistose rocks with abundant sericite, disseminated pyrite and a strongly deformed quartz-pyrite-chalcopyrite stockwork containing remarkably uniform copper and gold grades.

Iron Cap is in the upper sheet of the Mitchell thrust fault, and below the Sulphurets thrust. Chalcopyrite occurs as fine disseminations and quartz-pyrite veins. Epithermal style mineralization in quartz stockwork and breccias contain higher gold and silver grades are also present at Iron Cap. Original textures are commonly obliterated by intense, pervasive silicification. This mineralization style is similar to zones at the adjacent Brucejack property.

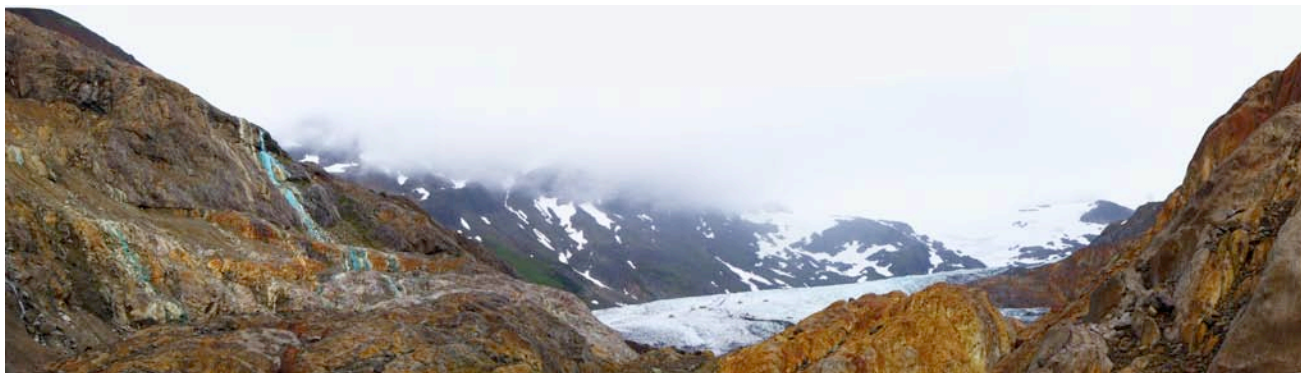


Figure 2.12. Looking east towards the Mitchell Glacier from the center of the Mitchell deposit. Malachite staining (left side) is precipitated from ground water flowing out of the Mitchell Fault. Early season drill pads (mid-center) melt resistively relative to surrounding snow and ice due to insulating straw. The Mitchell Glacier has retreated over 200 m since Seabridge began drilling the deposit in 2006.

### 2.3.4 Brucejack

High-grade gold-silver continues to be identified by Pretium Resources Inc at their **Brucejack** project located approximately 65 km north of Stewart and 5 km west of the Kerr Deposit of the KSM multi-deposit system. The 2012 drilling program was the largest in the region totalling 105 769 m in 298 diamond drill holes. The primary objective was to increase size and confidence of the high-grade resource at the Valley of the Kings (VOK) zone and gain a solid geological understanding of controls on mineralization. At 12.5 m centers, (Figure 2.13) the density of drilling has returned adequate data to produce a greatly improved geological understanding and an updated mineral resource estimate. Indicated resources total 16.1 Mt averaging 16.4 g/t Au and 14.2 g/t Ag; inferred resources total 5.4 Mt averaging 17.0 g/t Au and 15.7 g/t Ag. Both resource estimates are based on 5.0 g/t gold-equivalent cut-off grades. Best intercept to date on the property was drilled this year in SU-452: 0.5 m grading 41 582 g/t Au plus 27 725 g/t Ag from 201.47 m (Figure 2.3); part of a broader 10.71 m grading 2 393 g/t Au plus 1 605 g/t Ag from 198.79 m. To date, 66 intervals from VOK have returned grades over 1 000 g/t Au; 41 of which were drilled in 2012. The VOK zone is showing continuity to the Galena Hill zone and has been extended over 800 m along strike and remains open in all directions including to the west, across the Brucejack Fault. Additional West Zone measured plus indicated resources updated in April total 4.9 Mt averaging 5.85 g/t Au plus 267 g/t Ag. Additional inferred resources total 4.0 Mt grading 6.44 g/t Au plus 82 g/t Ag.

Due to the high-grade nature of the VOK deposit, strict modelling methods were used to mitigate over-smoothing of grades or “the nugget effect” in the resource estimate. The method included separating gold grades into two representative populations: 1) pervasive, background low grade up to 5 g/t Au and 2) discrete high-grade up to 421 g/t Au. Ordinary kriging on 10 m x 10 m x 10 m blocks was used to model the low grade populations while multiple indicator kriging was to

estimate high-grade populations and control the skewness of the data. The multiple indicator kriging does not exclude the extreme grades but does limit the influence of the high-grade sample in the block model. High and extreme grades are incorporated into a mathematical model then used to populate discrete sized blocks of high-grade mineralization which are incorporated into parent blocks twice the size of the low grade blocks, therefore limiting the influence of high grades while still acknowledging them. Further to the conservative estimation, areas of dense drilling data that approach the measured resource requirements outlined by the Canadian Institute of Mining have been retained in the indicated category until detailed underground sampling is done.

Underground re-development of the historic West Zone decline is well underway with slashing activities expanding the decline to 5 m x 5 m dimensions to the 1330 m level. From the 1314 m level, a new 450 m decline will be excavated to the 1270 m level in the VOK zone where a 10 000 tonne bulk sample will be mined in mid 2013 to validate continuity of high-grade mineralization. A feasibility study is expected to be completed by Q2 2013 and plans for a 2700 tonne per day underground mine. Planned mining method will be a combination of longitudinal and transverse long-hole stope mining followed by cemented paste backfill. Road access from highway 37 to the site is scheduled to be completed by the end of 2012.

Brucejack sits on the eastern limb of the broad northerly trending McTagg anticlinorium; a regional scale, mid-Cretaceous structural culmination in the Western Skeena Fold Belt. Brucejack property stratigraphy comprises of Triassic Stuhini Group sediments and volcanics unconformably overlain by Jurassic Hazelton Group volcanics followed by Bowser Lake Group sediments. Property lithologies generally dip moderately and young to the east and are variably altered. Lithologies are cut on the west side of the property by a topographic lineament, the Brucejack Fault (Figure 2.14) of uncertain displacement and interpreted history of





Figure 2.13. Drill pads spaced at 12.5 m at Brucejack's Valley of the Kings zone.



Figure 2.14. Overview of the Brucejack Property looking north, the Brucejack Fault is the lineament trending north-northwest. The VOK zone is at the center of the photo.

long-lived re-activation. Alteration is dominated by pervasive strong to intense quartz-sericite-pyrite replacement up to several hundred meters or more wide and approximately 5 km strike length. Most of the five defined mineral resources (West Zone, Valley of the Kings, Bridge Zone, Gossan Hill and Shore Zone) are within the intensely altered zone and associated with vein-stockwork systems of varying intensity. Stockworks display good continuity and in rare cases range up to 10 m wide. High-grade zones are either on the margins or contained within a zone of bulk low-grade mineralization up to several grams per tonne gold. Bulk low grade mineralization tends to be associated with disseminated anhedral pyrite, euhedral pyrite is barren.

Mineralization at the Brucejack property is hypothesized to represent a deformed transitional meso – epithermal porphyry-associated stockwork in pervasively altered lower Hazelton Group rocks; possibly associated with the high levels of the KSM porphyry system.

### 2.3.5 Tulsequah Chief

Chieftain Metals Inc is in the final stages of permitting for the past producing **Tulsequah Chief** mine (MINFILE 104K 002) located 100 km south of Atlin. Re-routing the road access from Atlin required an amendment to their existing Environmental Assessment (EA) and Special Use Permit (SUP), both inherited from previous owner Redfern Resources. The new road route begins from the terminus of the Warm Bay road and has significantly reduced environmental and cultural impacts. The new route is shorter by 35 km from the previously approved route, decreases the number of stream crossings by 24, avoids sensitive caribou habitat and eliminates the crossing of the culturally significant Nanika Heritage Trail. The SUP amendment process has been running parallel with the EA amendment process and is expected to be received by year end.

The water treatment plant (Figure 2.15) was commissioned in late 2011 and continued to operate through the spring freshet until late June. Treatment of the mine-impacted water showed a 98% reduction of metal loads and consistently achieved discharge levels below the Metal Mining Effluent Regulations. However, due to plant efficiency issues and higher than anticipated costs, operations were suspended in June while Chieftain reviewed plans to increase operational efficiencies.

A feasibility study released in December outlines a 2000 tonne per day underground mining operation with an estimated 9 year mine life and \$439.5 million initial capital expenditure. Mining will be conducted primarily by sub-level stoping with minor mechanized cut-and-fill stoping followed by paste and waste-rock backfill. Probable reserves total 6.45 Mt grading 2.30 g/t Au, 81.38 g/t Ag, 5.59% Zn, 1.12% Cu and 1.04% Pb. Processing will consist of a primary crushing plant, grinding and flotation plant, effluent treatment plant, and backfill plant. Processing will produce copper, lead and zinc concentrates and gold dore'. Project construction is



Figure 2.15. The water treatment plant at Tulsequah Chief reduced metal loading by 98%.



planned to commence in spring 2013 followed by site construction in late 2014 and commissioning by late 2015.

China CAMC Engineering Co. Ltd. (CAMCE) and its majority owned Procon Holdings Inc (Procon) have signed a Memorandum of Understanding with Chieftain to acquire a 30% interest in the Tulsequah Project for a cash contribution of equal to 30% of the net present value of the project. Chieftain will own the remaining 70%. An engineering, procurement and construction contract with CAMCE to develop the project will be followed by a mining contract with Procon for the “life of mine”. CAMCE is arranging to secure long-term debt for up to 70% of the project financing from a Chinese institution while also seeking an arrangement of 30% of zinc, copper and lead concentrates from the project.

Tulsequah Chief is a Kuroko type volcanogenic massive sulphide deposit in which numerous stacked sulphide lenses are present within a rhyolite-dominated sequence of volcanic flows and fragmental units. Mineralization in all lenses consists of massive to semi-massive pyrite, chalcopyrite, sphalerite and galena. Accessory ore minerals include tetrahedrite-tennantite and rare native gold. Gangue mineralogy consists of barite, chert, gypsum, anhydrite, carbonate quartz, chlorite and sericite and silicified volcanoclastics.

### 2.3.6 Kitsault

Avanti Mining’s past producing **Kitsault** (MINFILE 103P 120) molybdenum mine (Figure 2.16) is located 140 km northeast of Prince Rupert and is in the late stages of the Environmental Assessment process. A decision is expected in early 2013. The EA package was formally accepted by federal and provincial regulators in late April 2012. Avanti released an updated measured plus indicated resource estimate in April totalling 321.8 Mt grading 0.071% Mo, 236 g/t Pb and 4.8 g/t Ag with additional inferred resources totalling 317.6 Mt grading 0.041% Mo, 237 g/t Pb and 4.6 g/t Ag.

Mine life is forecast to be 16 years with an initial capital cost of \$837 million.

Kitsault operated from 1967–72 and again from 1981–82, milling a total of 13.4 Mt grading 0.101% Mo. Total past production was 13.6 tonnes Mo. The site is still serviced by a mine access road and power.

The Kitsault property is located approximately within the western margin of the Bowser Basin as part of the Intermountain tectonic belt a few kilometres east of the Coast Plutonic Belt contact within the Lime Creek Intrusive Complex. Mineralization is hosted within multiphase diorite, quartz monzonite and younger felsic units. Cross-cutting relationships indicate multiple mineralizing events occurred. Geometry of mineralization appears to be annular in plan and arcuate in section.



Figure 2.16. The past producing Kitsault molybdenum mine from 1967-1972 and again from 1981-1982 and milled 13.4 Mt grading 0.101% Mo.

### 2.3.7 Kutcho Creek

Capstone Mining Corporation continues to gather baseline data for their **Kutcho Creek** copper-zinc project (MINFILE 104I 060) Environmental Assessment package submission expected in 2013. Current activities are limited to basic site engineering and preparations for EA submission. An updated mine design includes a starter open pit at the Main Zone and underground mining methods employed at the Esso zone.

Probable mineral reserves total 10.44 Mt of averaging 2.01% Cu, 3.19% Zn, 34.61 g/t Ag and 0.37 g/t Au. Measured and indicated resources (inclusive of reserves) total 11.28 Mt averaging 2.19% Cu, 3.28 % Zn, 36.7 g/t Ag and 0.39 g/t Au. Additional inferred resources total 1.09 Mt averaging 1.74% Cu, 2.04% Zn, 30.7 g/t Ag and 0.35 g/t Au. Proposed mine life is 12 years with a processing capacity of 2500 tonnes per day producing separate copper and zinc concentrates. Capital costs are an estimated \$ 213.5 million, which includes a Liquefied Natural Gas power plant making the project independent of the Northwest Transmission Line.

The Kutcho property contains three known Kuroko-type volcanogenic massive sulphide (VMS) deposits. These are aligned in a westerly plunging linear trend and from east to west they are referred to as the Main, Sumac, and Esso deposits. The largest of the three, the Main deposit, is exposed near the eastern end of this trend, whereas the Esso deposit occurs at depths about 400-600 metres below surface at the western or down plunge end of the trend as it is currently known. The Sumac deposit lies between the Main and Esso deposits both laterally and vertically, but has seen only cursory drilling. The mineralized trend is open down plunge but is poorly explored.

### 2.3.8 Granduc

The past producing Granduc copper-gold-silver massive sulphide deposit (MINFILE 104B 021) received significant exploration and evaluation during 2012 completed by Castle Resources Inc. The former mill site and portal (Figure 2.17) are located 35 km north of Stewart at the north terminus of the Granduc Mine road where the refurbished 17 km tunnel provides access to the underground deposit. An updated resource estimate of the combined Main and North Zones was released in December using a 0.8% copper equivalent cut-off grade. Measured plus indicated resources total 11.32 Mt grading 1.47% Cu, 0.17 g/t Au and 12.4 g/t Ag. Additional inferred resources total 44.63 Mt grading 1.43% Cu, 0.19 g/t Au and 10.7 g/t Ag. The Main Zone contains measured resources totalling 5.16 Mt averaging 1.58% Cu and an indicated resource of 2.95 Mt grading 1.39% Cu. Main Zone inferred resources total 30.52 Mt grading 1.40% Cu. The North Zone inferred resource is 14.11 Mt grading 1.49% Cu.

Site activities included 24 000 m of diamond drilling (Figure 2.18) with 32 holes focussed on following up high-grade copper intercepts the South Zone and North Zone drilled in 2011. Drilling at the South zone tested above the 2011 resource and confirmed high grade copper mineralization continues. At the North zone, 100 m step-out drilling gained better orientation of mineralization originally discovered by previous mine operators Esso and Newmont. Other site activities included underground re-development on the 2600 level consisting of installing

ventilation, communications, power, establishing drainage and removal of historic rail. Castle Resources intends to release a preliminary economic assessment and enter the Environmental Assessment process in early 2013.

Granduc is a Triassic, Besshi -type volcanogenic massive sulphide deposit with tabular ore zones deformed by at least three phases of folding. Massive sulphide assemblages consist of pyrite, pyrrhotite, chalcopyrite with lesser interstitial sphalerite and galena. Massive sulphides occur at the contact between mafic pillow basalts and tuffs and overlying chert and argillite.

### 2.3.9 Schaft Creek

Copper Fox Metals Inc continued exploring extensions and testing geophysical anomalies of the **Schaft Creek** (MINFILE 104G 015) copper-gold-silver-molybdenum project located approximately 60 km northwest of Bob Quinn Lake. An updated resource estimate announced in May reported measured resources totalling 146.6 Mt grading 0.31 % Cu, 0.24 g/t Au, 1.78 g/t Ag and 0.017% Mo; indicated resources totalling 1 081 Mt grading 0.26% Cu, 0.19 g/t Au, 1.69 g/t Au and 0.017 g/t Ag and inferred resources totalling 597.1 Mt grading 0.22% Cu, 0.17g/t Au, 1.65 g/t Ag and 0.016% Mo. Copper Fox is expected to release a feasibility study by the end of 2012.

Ground activities included geophysical surveys, drilling, ground truthing targets, and acquisition of adjoining mineral tenures. A total field magnetic survey



Figure 2.17. Looking west-northwest over the former Granduc mill site towards the Berendon Glacier. This is the portal entrance to the refurbished 17 km Tide Lake Tunnel which serviced the underground mine workings during past operation from 1970 - 1984.





Figure 2.18. Castle Resources drilled 24 000 m in 2012 including these two at the North Zone.

added 2500 line km to the existing surveyed area and helped define targets drilled later in the year. Drilling totaled 2263 m and generally targeted IP signatures similar to those associated with known mineralization in the Schaft Creek trend. Highlight results included 47.0 m grading 0.62% Cu, 0.59 g/t Au, 2.02 g/t Ag and 0.006% Mo from 509.0 m in drill hole CF-427-2012. Further testing returned lesser grades but did increase confidence of interpreted continuity of mineralization and the large scale of the system.

### 2.3.10 Galore Creek

The **Galore Creek** (MINFILE 104G 090) copper – gold project is co-owned by Novagold and Teck and located approximately 150 km northwest of Stewart. This year's activities continued to upgrade resource confidence and optimize geotechnical challenges with approximately 25 000 m of drilling. Results of the field program are currently being assembled and reviewed. Other project activities include additional engineering studies, site care and maintenance and baseline environmental monitoring.

Nova Gold's 50% of the project remains for sale with intentions to have engaged a purchaser by year end. Galore Creek is a late Triassic porphyry copper deposit associated with alkalic intrusive rocks. Proven and probable reserves total 528 Mt averaging 0.59% Cu + 0.32 g/t Au + 6.02 g/t Ag. Additional measured plus indicated resources total 286.7 Mt averaging 0.33% Cu, 0.24 g/t Au and 3.64 g/t Ag. Inferred resources total 346.6 million tonnes averaging 0.42% Cu + 0.24 g/t Au + 4.28 g/t Ag.

### 2.3.11 Dome Mountain

Metal Mountain Resources Inc wholly owned subsidiary Gavin Mines Inc continued development of their **Dome Mountain** gold mine (MINFILE 93L 276)

located approximately 38 km east of Smithers. The company has determined a mill is needed for the site.

Despite substantial efforts including shipping of approximately 5 000 tonnes of ore, a long term arrangement could not be reached with off-site mill operations. A working group has been assembled and a scoping study is well underway to build a 250 tonne per day mill and acquire the necessary permit amendments. Estimated capital costs and an updated resource estimate will be included in a future pre-feasibility report. On-site milling would result in lower required cut-off grades and therefore extended mine life. Site activities have slowed for the winter season while all focus is applied to the acquisition and permitting of an on-site mill.

Underground development in early 2012 advanced workings to the first cut and fill stope on the 1290 level and produced 1385 tonnes from the Boulder vein; face samples averaged 9.38 g/t Au. Other underground activities included vent raise development and diamond drilling. Surface activities involved completion of additional site infrastructure including fuel storage and distribution system, maintenance shop, installation of a 400 KV generator and road improvement designs for mine traffic. The water treatment plant has been operating smoothly since March and is achieving performance requirements. Metal Mountain entered into an option agreement with Gaurdsman Resources Inc to acquire 36 mineral tenures adjacent to the Dome project and the 3% NSR associated with the Fedral Creek property.

Dome Mountain comprises eight (or more) gold-bearing orogenic quartz veins within volcanic and sedimentary rocks of the Hazelton Group. The Boulder quartz-sulphide vein is in a fault and itself shows evidence of shearing. Principal ore minerals are pyrite and sphalerite with minor chalcopryrite, galena, arsenopyrite and tetrahedrite. Gold occurs in native form but is rarely visible and is typically associated with pyrite.

### 2.3.12 Bell and Granisle

X-Strata Copper completed two drill programs in 2012 on their past producing **Bell** (MINFILE 93M 001) and **Granisle** (MINFILE 93L 146) mines located 11 km and 7 km respectively northeast of the village of Granisle. Both drill programs were divided between resource definition, geotechnical and metallurgical objectives. Drilling results were not available. Historic documents indicate over 70 Mt of non 43-101 compliant copper reserves remain in the bottom of the Bell Pit grading 0.23g/t Au, 0.46% Cu plus 0.48 g/t Ag (Figure 2.19). Additional non-43-101 compliant in-situ reserves at Granisle total 119 Mt grading 0.41% Cu plus 0.15 g/t Au using a 0.30% Cu cut-off grade. Mining ceased in 1992 and since then, meteoric water has been filling the pits (Figure 2.20) and water levels are expected to surpass



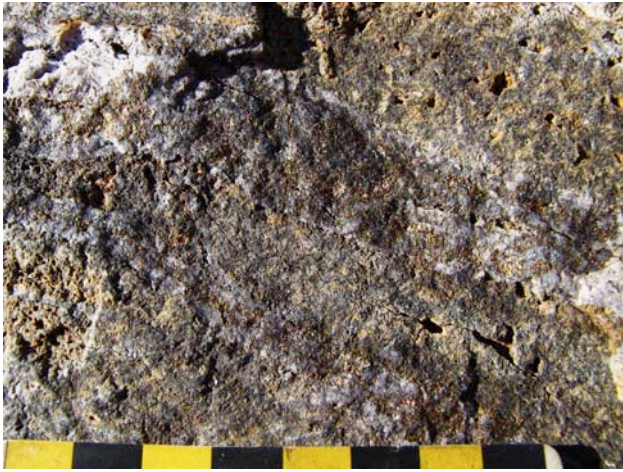


Figure 2.19. Chalcopyrite mineralization from the past producing Bell copper mine. X-Strata is evaluating options surrounding a significant minable reserve at the bottom of Bell along with rising pit water levels.



Figure 2.20. Strong iron oxidation in the Granisle pit walls.

surrounding Babine Lake levels in 3-5 years. During the 2012 summer, a pilot water treatment plant was trialed with positive results.

The Bell mine is hosted in Eocene biotite-feldspar porphyry stocks of the Babine Intrusions and cut by the northwest trending Newman Fault. The Granisle mine is set in a similar geologic setting as Bell but interpreted to be exposed at deeper stratigraphic levels.

### 2.3.13 Morrison

The Morrison copper gold project (MINFILE 93M 007) is located 70 km northeast of Smithers and owned by Pacific Booker Minerals Inc. An Environmental Assessment package was formally accepted in Q3 2010 and then suspended at day 178 of the 180 day review period. An independent review of environmental baseline data acquired by Pacific Booker was completed and the EA review was complete by late August. On October 1<sup>st</sup>,

the decision was made to not issue an Environmental Certificate for the Morrison project. Energy, Mines and Natural Gas Minister Rich Coleman and Environment Minister Terry Lake announced "potential long-term risks of the project outweighed the potential benefits to the province."

Measured plus indicated resources total 206.869 Mt grading 0.39% Cu, 0.20 g/t Au and 0.005% Mo. Inferred resources total 56.524 Mt grading 0.40% Cu, 0.21 g/t Au and 0.005% Mo. The deposit is hosted in an Eocene biotite-feldspar porphyry within the Babine Intrusions.

### 2.3.14 Silvertip

Silvercorp Metals Inc continued evaluation of their **Silvertip** silver-lead-zinc-gold project (MINFILE 104O 038) located approximately 90 km west-southwest of Watson Lake and bounded to the north by the Yukon border. The company is in the process of preparing a Mine Permit application with hopes of receipt in 2013. Access to site was severely restricted in 2012 due to heavy rains washing out numerous river crossings. Site activities were limited this year to visits from independent qualified professionals who then co-authored an updated resource estimate released in July and a preliminary economic assessment (PEA) released in November. Resource estimates are divided between two mineralization zones: 1) the high-grade, Manto-replacement hosted Lower Zone, and 2) the exhalite hosted Upper Zone. Lower Zone indicated resources total 2.45 Mt grading 315 g/t Ag, 5.88% Pb, 6.26% Zn and 0.413 g/t Au with additional inferred resources totalling 1.64 Mt grading 281 g/t Ag, 4.55% Pb, 5.64% Zn, and 0.093 g/t Au. Cut-off grade is 325 g/t silver equivalent. Upper Zone inferred resources total 3.63 Mt grading 39 g/t Ag, 0.65% Pb and 2.36% Zn using a \$25 per tonne cut-off.

The PEA outlines three mining scenarios of variable milling rates and seasonal operations which would cap annual milling at 75 000 tonnes per year. Proposed mining would be an underground drift and fill method with access provided from the existing portal and new declines developed to access the Silver Creek and Discovery Zones. Open pit mining was not fully evaluated in this study due to a high strip ratio and unfavorable topography for waste-rock storage.

### 2.3.15 Yellow Giant

Banks Island Gold Ltd has given production notice to Imperial Metals Corp regarding the development of the Yellow Giant gold project (MINFILE 103G 021) located on Banks Island, approximately 120 km south of Prince Rupert. Banks Island Gold Corp holds 100% interest of the property and as stipulated by option agreement, Selkirk (bought by Imperial) has the right by "Back-In-

Option” to re-acquire 51% of the property by funding 2.5 times the amount Banks Island has spent on the project to date.

Project activities completed in 2012 included drilling, metallurgical testing, geological mapping, and prospecting. Multiple conductors identified by a 2011 VTEM airborne geophysical survey confirmed areas of known mineralization and generated follow up targets in unexplored areas. Drilling in 2012 totalled 3801m in 30 holes in 3 zones: 1923 m in 9 holes at the Tel Zone, 819 m in 9 holes at the Bob zone and 1059 m in 12 holes at the Discovery zone. All zones returned significant gold grades with best intercepts summarized in Table 2.4. Bench-scale metallurgical tests completed on composite samples from the Bob, Tel and Discovery zones returned 90% average gold recovery from an average 109 g/t Au concentrate.

Banks Island Gold Ltd has procured some mining equipment in preparation for a very active year in 2013. Purchased equipment includes two floating, amenity inclusive camp facility barges with up to 50 person capacity and a re-furbished dense media separation plant. Equipment will be re-located to Banks Island to support proposed 2013 activities including bulk sampling at the Bob and Kim zones, pilot mining at the Tel zone, exploration drilling, road construction and environmental baseline monitoring. Off-site activities will include site engineering and metallurgical testing.

Yellow Giant consists of four zones containing 43-101 compliant resources updated in October 2012 and outlined in Table 2.5. Mineralization occurs as quartz-carbonate bearing pyrite-pyrrhotite massive sulphide veins with minor amounts of interstitial native gold, sphalerite and galena (Figure 2.21). Higher grade shoot geometry measures up to 50 m apparent strike length and over 150 m deep. Veins are controlled by steeply dipping first and second order shear structures and range from 0.5 to 5.0 m wide. Known mineralization is closely associated with the Arseno and Hepler regional faults which separate Ordovician to Triassic metasediments from mid-late Jurassic intrusives.

## 2.4 MINERAL EXPLORATION

Table 2.3 provides a summary of 2012 projects.

### 2.4.1 Porphyry Copper projects

“Porphyry copper deposits in the northwest commonly contain significant gold or molybdenum. Few deposits contain all three metals in economically significant amounts. Prospects in the Iskut-Stikine district developed in late Triassic to early Jurassic intrusions within the Stikine terrane prior to accretion to North America. Pre-accretion porphyry prospects are primarily copper-gold deposits; molybdenum is significant only at Schaft Creek. The intrusions are sub-alkalic, potassium

rich and intermediate composition, typically monzonites and their volcanic equivalent. Potassium feldspar porphyritic rocks are common. Alkalic rocks, syenite and pseudoleucite-bearing trachyte characteristic of the Galore Creek deposit represent an end-member composition. Some porphyry deposits in the Stikine district have an extremely high gold to copper ratio and are referred to as gold-copper porphyries. This includes the porphyries at KSM and Bronson Slope deposits.

Porphyry copper-molybdenum prospects predominate in the Skeena region. Some copper-gold prospects occur but the gold content is appreciably less relative to the Iskut-Stikine district. Skeena region porphyry prospects are all contained in post-accretion intrusions including the extensive late Cretaceous Bulkley and more localized Eocene Nanika and Babine calkalkaline intrusions. The three suites have separate distribution patterns but all occur within the transverse geologic feature known as the Skeena Arch. The Huckleberry deposit is related to a Bulkley intrusion.” (Revised from Wojdak, 2010)

#### 2.4.1.1 Porphyry Copper-gold Projects in Stikine Terrane, Iskut District

With the construction of the Red Chris Mine in full force, many other companies are exploring for similar deposits in the area. Broad regional-scale generative programs were completed by large companies including Teck and Hunter Dickinson Inc. Each company acquired thousands of square kilometers of mineral claims and conducted abundant geochemical sampling, prospecting, mapping and some geophysical surveys; complimentary to recent GeoScience BC regional Quest Northwest programs. Dozens of new showings of visible copper mineralization have been reported and will likely be followed up in 2013. Smaller tenure holders in close proximity to Red Chris include Colorado Resources Ltd and Victory Ventures Inc who are following up the **Eldorado** (MINFILE 104H 026) and **Capau** (MINFILE 104H 036) prospects respectively with geophysical and geochemical surveys.

West Cirque Resources identified porphyry style copper-gold mineralization 68 km south of Dease Lake and 25km northwest of Red Chris at their **Castle** (MINFILE 104G 076) project jointly held in part with Bearclaw Capital Corp. A formerly unknown deposit type associated with a 5.5 km long alteration zone and coincident Au-Cu geochemistry gave West Cirque ample reason to follow up. Reconnaissance ground truthing and prospecting completed in 2011 identified porphyry style mineralization east of historic drilling and were the initial basis for generating drill targets for 2012 (Figure 2.22). Of the Six holes totalling 1777 m, five returned significant gold-copper values. Drill hole CA12-05 returned 34 m grading 1.015 g/t; CA12-04 returned 14 m grading 0.425 g/t Au plus 0.20% Cu. Mineralization is hosted primarily in monzonite - monzodiorite intrusive rocks and occurs mainly as pyrite and chalcopyrite

**TABLE 2.3. SELECTED EXPLORATION PROJECTS, SKEENA REGION, 2012**

Property	Proponent	MINFILE	Commodity	Deposit Type	Work (Proposed) Actual
<b>Babine (Astorius)</b>	Astorius Resources Ltd	093L 209	Cu	Porphyry	GC, IP, AB-MG, G,
<b>Ball Creek</b>	Blue Gold Mining	104G 018	Cu, Au	Porphyry	DD (4 108 m,
<b>Bell Copper</b>	Xstrata Copper Canada Ltd	093M 001	Cu, Au	Porphyry	DD, GP, GD, MS,
<b>Bronson Trend</b>	Snip Gold Corp.	104B 077	Au, Cu, Ag	Porphyry	DD (2 437 m, 9 holes), BPEM
<b>Brucejack</b>	Pretium Resources Inc.	104B 193	Au, Ag	Porphyry	DD(105 769 m 298 holes), GD, G, GC, UG (500 m slash)
<b>Buck</b>	Quartz Mountain Resources Ltd	093L 009	Au, Ag, Zn, Pb	Vein / Breccia	G
<b>Capau</b>	Victory Ventures Inc	104H 036	Au, Cu, Ag	Porphyry	IP, GC, AB-MG
<b>Cassiar Gold</b>	China Minerals Mining Corp	104P 012	Au	Vein / Breccia	DD (8 197 m, 53 holes)
<b>Cassiar Jade</b>	Dynasty Jade Ltd.	104J 057	Jade	Other	Jade extraction
<b>Cassiar Jade</b>	Cassiar Jade Contracting	104P 005	Jade	Other	Jade extraction
<b>Castle</b>	West Cirque Resources	104 G 076	Au, Cu	Porphyry	DD (1 777 m, 6 Holes), IP, MG,
<b>Clone</b>	Teuton Resources Corp & Canasia Industries Corp	103P 251	Au	Vein / Breccia	OP-BU
<b>Coles Creek</b>	Callinan Mines Ltd.	93E 041	Cu, Au, Ag	Porphyry	DD, AB-GP, G
<b>Columario</b>	Argonaut Exploration Inc.	103I 077	Au	Vein / Breccia	DD (725.4 m, 4 holes), G, Corporate
<b>Deer Horn</b>	Deer Horn Metals	093E 019	Au, Ag, Te	Vein / Breccia	G, GC
<b>Dilworth - Big Missouri</b>	Ascot Resources Ltd.	104B 044	Au, Ag	Vein / Breccia	DD (36 942 m, 166 holes), G, Corporate
<b>DOK</b>	Boxxer Gold Corp	104G 043	Cu, Au, Ag	Porphyry	G, GC,
<b>Dolly Varden</b>	Dolly Varden Silver Corporation	103P 188	Ag	Vein / Breccia	DD (1 728 m, 6 holes), AB GP (ZTEM, 733 line km), G, GC, Corporate, EN, UG (rehab)
<b>Dome Mountain</b>	Gavin Mines Ltd	093L 022	Au	Vein / Breccia	DD, Corporate, EN, UG,
<b>Eagle, Mcbride, Pitman</b>	Teck Resources Limited		Cu, Au	Porphyry	Regional G, GC,
<b>Eaglehead</b>	Carmax Explorations Ltd.	104I 008	Cu, Mo	Porphyry	Corporate
<b>Eldorado</b>	Colorado Resources Ltd	104H 026	Cu, Au	Porphyry	IP, GC,
<b>Engineer</b>	BC Gold Corp.	104M 014	Au	Vein / Breccia	Corporate, M, UG (dewatering) G,
<b>Fireside</b>	Fireside Minerals Ltd.	094M 003	Barite	Other	RC, G,
<b>Four Js</b>	Rotation Minerals Ltd. / Teuton Resources Corporation	104B 124	Au, Ag, Cu	Vein / Breccia	DD (1 345 m, 25 holes), GC, TR
<b>Galaxie</b>	Quartz Mountain Resources Ltd		Cu, Au	Porphyry	G, GC,
<b>Galore Creek</b>	Galore Creek Mining Corp.	104G 090	Cu, Au	Porphyry	DD (25 000 m), EN, G, GD
<b>GJ (Kinaskan)</b>	Teck Resources Limited	104G 034	Cu, Au	Porphyry	(IP-Mag, 100 km; ddh)
<b>Gnat Pass</b>	Quartz Mountain Resources Ltd	104I 001	Cu, Au	Porphyry	DD
<b>Golden Eagle</b>	Troymet Exploration Corp	104M 044	Au	Vein / Breccia	(IP; ddh)
<b>Granduc</b>	Castle Resources Inc.	104B 021	Cu, Au, Ag	Massive Sulphide	DD ( 24 000 m), UG, EN, Corporate
<b>Groundhog</b>	Atrum Coal	104A 078	Anthracite	Metallurgical Coal	DD ( 4 992 m, 15 holes),



TABLE 2.3 (continued)

Property	Proponent	MINFILE	Commodity	Deposit Type	Work (Proposed) Actual
<b>Heart Peaks</b>	Colorado Resources Ltd	104K 084	Au	Vein / Breccia	G, GC
<b>High</b>	Teuton Resources Corporation	104B	Au	Vein / Breccia	DD (1 346 m, 3 holes)
<b>High Gold</b>	Argonaut Exploration Inc.	093L 076	Cu, Au	Vein / Breccia	Corporate
<b>Homestake Ridge</b>	Bravo Gold Corp.	103P 216	Au, Ag, Zn	Vein / Breccia	DD (4 743 m, 13 holes), EN, G, Corporate
<b>Huckleberry Mine</b>	Huckleberry Mines Ltd.	093E 037	Cu, Mo	Porphyry	DD, (5 141 m, 15 holes), IP, MZO development
<b>Jewelry Box</b>	International Samual / lucky Strike Resources	093L 321	Cu, Au	Porphyry	G
<b>Kalum</b>	Eagle Plains Resources Ltd. / Clemson Resources Corp.	103I 228	Au, Ag	Vein / Breccia	DD (400 m, 2 holes)
<b>Kitsault Mine</b>	Avanti Mining Inc	103P 120	Mo	Porphyry	EN
<b>KSM</b>	Seabridge Gold Inc.	104B 103	Au, Cu	Porphyry	DD (23 442 m), GD, EN, G
<b>Kutcho Creek</b>	Capstone Mining Corp.	104I 060	Cu, Zn, Ag, Au	Massive Sulphide	EN, Corporate
<b>Kutcho Jade</b>	The Continental Jade Ltd	104I 078	Jade	Other	Jade extraction
<b>Lennac Lake</b>	Riverside Resources	093L 190	Cu, Mo	Porphyry	DD (1 485 m 4 holes), RC (1 987 m, 93 holes), IP (45.6 line km), AB-GP (4 532 line km, mag), G
<b>Lone Pine</b>	Bard Ventures Ltd.	093L 027	Mo	Porphyry	Corporate, G
<b>Metla</b>	Ocean Park Ventures Corp	104K 113	Au	Vein / Breccia	G
<b>Morrison</b>	Pacific Booker Minerals Inc.	093M 007	Cu	Porphyry	EN, Corporate
<b>Arctos (Klappan)</b>	Fortune Minerals Limited	104H 022	Coal	Metallurgical Coal	FS, EN,
<b>New Nanika</b>	New Chris Minerals	093E 055	Cu, Mo	Porphyry	DD?, G, GC
<b>New Polaris</b>	Canarc Resource Corp.	104K 003	Au	Vein / Breccia	Corporate
<b>Newmont Lake</b>	Romios Gold Resources Inc.	104B 281	Au, Ag	Skarn	DD (2 613 m, 15 holes), G, GP (AMT)
<b>Oosta</b>	Goldreach Resources Ltd.	093E 105	Cu, Au	Porphyry	DD (45 147 m, 67 holes), G, IP, TR
<b>Poly</b>	Frontline Gold Corp	104A 177	Au, Ag	Vein / Breccia	GC, G
<b>Poplar</b>	Lions Gate Metals Inc.	093L 239	Cu, Mo	Porphyry	Corporate
<b>Provencher Lake - Letain</b>	Glenpark Enterprises Ltd.	104I 092	Jade	Other	Jade extraction
<b>Red Chris</b>	Imperial Metals Corp. (Red Chris Development Company Ltd.)	104H 005	Cu, Au	Porphyry	DD (5 5415.1 m, 5 holes), EN, Mine Constrction
<b>Red Cliff (Montrose)</b>	Decade resources Ltd. / Mountain Boy Minerals Ltd.	104A 033	Au	Vein / Breccia	DD (73 holes)
<b>Red Mountain</b>	Banks Island Gold	103P 086	Au	Other	PEA, G
<b>Schaft Creek</b>	Copper Fox Metals Inc.	104G 015	Cu, Mo, Au	Porphyry	DD (2 263 m), GP, GC, G, FS
<b>Scottie Gold</b>	Rotation Minerals Ltd.	104B 034	Au, Ag, Cu, Zn, Pb	Vein / Breccia	Corporate, GC, G
<b>Silver Coin</b>	Jayden Resources Inc - Mountain Boy Minerals Ltd JV	104B 150	Au, Ag, Pb, Zn	Vein / Breccia	Corporate

(continued on following page)

**TABLE 2.3 (continued)**

Property	Proponent	MINFILE	Commodity	Deposit Type	Work (Proposed) Actual
<b>Silver Hope</b>	Finlay Minerals Ltd.	093L 256	Ag, Cu	Vein / Breccia	AB-GP, G
<b>Silver Queen</b>	New Nadina Explorations Limited	093L 002	Cu, Mo	Porphyry	DD (2 400 m, 3 holes), DCIP / MT (21.6 km), G
<b>Silverknife</b>	Teryl Resources Corp. / minewest Silver and Gold	104O 048	Ag, Zn, Pb, Re	Sedimentary Replacement	G, GC
<b>Silvertip</b>	Silvercorp Metals Inc.	104O 038	Ag, Pb, Zn, Au	Sedimentary Replacement	Corporate, PF, PEA
<b>Silver Vista</b>	Amarc Resources Ltd	093M 195	Ag, Cu	Vein / Breccia	AB-GP (2 700 line km, mag), GC, G,
<b>Surf Inlet</b>	Rupert Resources Ltd.	103H 027	Au	Vein / Breccia	G
<b>Table Mountain</b>	China Minerals Corp.	104P 029	Au	Vein / Breccia	DD (1 340 m, 10 holes)
<b>Telkwa Coal</b>	Carbon Development Partnership (Sherritt International Corp)	093L 152	Thermal Coal	Thermal Coal	Corporate
<b>Tennyson</b>	Teuton Resources Corp.	104B 167	Cu, Au	Porphyry	G, GC, MG, IP,
<b>Thorn</b>	Brixton Metals Corp	104K 031	Au, Cu	Vein / Breccia	DD (2 890 m), GC, G
<b>Tide</b>	Hunter Dickenson Inc	104B 129	Au, Ag, Pb, Zn	Vein / Breccia	G, GC
<b>Trapper Lake</b>	Ocean Park Ventures Corp	104K 078	Au	Vein / Breccia	G
<b>Trek</b>	Romios Gold Resources Inc.	104G 022	Au, Cu	Vein / Breccia	G, Corporate
<b>Troitsa</b>	Callinex Mines Ltd.	093E 005	Au	Porphyry	(IP, 33 km; ddh, 3000 m year 1)
<b>Tulsequah Chief</b>	Chieftain Metals Inc	104K 002	Cu, Zn, Ag ,Au	Massive Sulphide	Corporate, EN
<b>Turnagain</b>	Hard Creek Nickel Corp	104I 119	Ni, Cu, Co, Pt, Pd	Magmatic	EN
<b>Vines Lake</b>	Lomiko Resources Inc.	104P 078	Au	Vein / Breccia	G
<b>Wale / Orca</b>	First Point Minerals Corp.	140I 128	Ni, Fe	Serpentine UM	DD (2 764 m, 10 holes) OP-BU (5 T), GP (69 km), G
<b>Yellow Giant</b>	Banks Island Gold	103G 021	Au, Ag	Vein / Breccia	DD (3 801 m, 30 holes), M, G, Corporate
<b>Yellow Jacket</b>	Eagle Plains Resources Ltd	104N 043	Au	Vein / Breccia	G
<b>Zymo</b>	Eastfield Resources	093L 324	Cu, Au	Porphyry	DD (2 322 m, 7 holes), G

**Work Program Abbreviations:**

A = access (trail, road construction on claims; AB-EM = airborne electromagnetics; AB-MG = airborne magnetics; AB-RD = airborne radiometrics; BU (X tonnes) = bulk sample (weight in tonnes if known); CD = condemnation drilling; CQ = coal quality testing; CT = carbonization test (coal); DD (Xm) = diamond drilling totalling X metres; EN = environmental baseline studies/monitoring, remediation work; FS = feasibility studies; G = geology, mapping etc.; GC = geochemical sampling (rock, soil, silt etc.); GD = geotechnical drilling; GP = geophysics (general); IP = induced polarization; 3D-IP; MG = magentics; MK = marketing (primarily for industrial mineral products); MS = metallurgical studies; OB = overburden drilling; OP-BU = open pit bulk sample; P = prospecting; PD = percussion drilling; PF = pre-feasibility studies; PP = pilot plant; R = reclamation; RC (Xm) = reverse circulation drilling totalling X metres; TR = trenching; UG (Xm) = X metres of underground development; UG-BU = underground bulk sample; UT = UTEM;

**TABLE 2.4. BEST 2012 DRILLING RESULTS FROM YELLOW GIANT GOLD PROJECT.**

Zone	Hole	From (m)	To (m)	Core Interval (m)	Estimated True Width (m)	Au (g/t)	Ag (g/t)
Discovery	DIS-12-03	68.8	72.5	3.7	2.6	135.5	48
Discovery	DIS-12-01	53	54.5	1.5	1.4	31	38
Tel	BIG-12-29	210	212.95	2.95	2.09	50.8	43
Bob	BOB-12-07	37.9	44.3	6.4	5.0	41.5	126
Bob	BOB-12-01	45.6	49	3.5	2.9	35.4	125
Bob	BOB-12-04	41.5	45.5	4	3.3	39.1	113

**TABLE 2.5. YELLOW GIANT PROJECT RESOURCES\***

Zone	Measured			Indicated			Inferred		
	Tonnes	Au Grade (g/t)	Ag Grade (g/t)	Tonnes	Au Grade (g/t)	Ag Grade (g/t)	Tonnes	Au Grade (g/t)	Ag Grade (g/t)
Tel	15,000	21.1	43	21,000	18.5	41	8,000	20.6	40
Bob	6,000	32	63	11,000	30.9	58	8,000	29.3	50
Discovery	10,000	22.1	36	15,000	22.8	36	6,000	30.8	36
Kim							59,000	8.9	29
<b>Total</b>	<b>31,000</b>	<b>23.4</b>	<b>44</b>	<b>47,000</b>	<b>22.7</b>	<b>43</b>	<b>81,000</b>	<b>13.7</b>	<b>33</b>

\*Courtesy of Banks Island Gold Corp, October 17 2012.

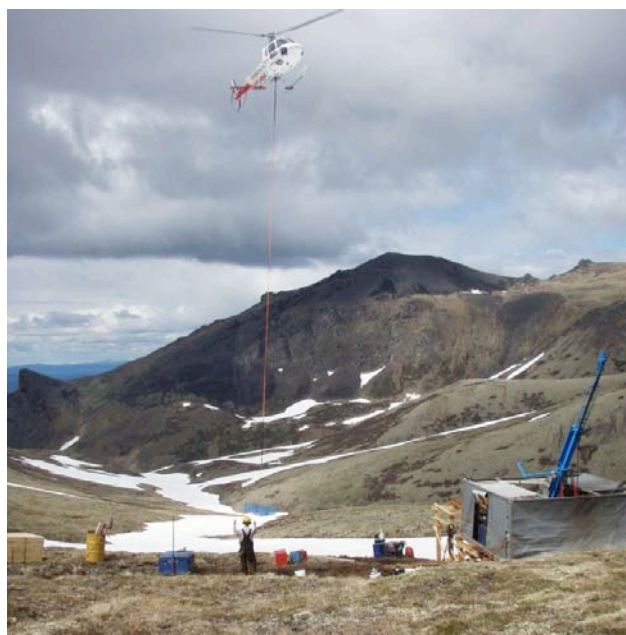


Figure 2.22. West Cirque resources drilling at the newly recognised Castle porphyry target.

disseminations, fracture-fillings and veins often associated with magnetite. Other characteristic porphyry textures observed include: quartz stock working, quartz-sericite-pyrite alteration and variable potassium feldspar flooding. Following the drill program, ground magnetics and IP were completed to increase geological understanding and successfully generate follow up drill targets.

Paget Resources partnered with Blue Gold Mining to keep exploring the **Ball Creek** (MINFILE 104G 018) copper-gold-molybdenum-silver project centrally located between Galore Creek, Schaft Creek, Red Chris and 8 km west of highway 37. Airborne magnetics and ground IP anomalies coupled with surface geological mapping and geochemistry further defined drill targets in the Main zone, also described as a 1400 x 500 m zone of copper-gold mineralization associated with known monzonite porphyry bodies. Drilling totalled 4108 m and successfully identified broad intercepts of gold-copper mineralization including 307.0 m grading 0.44 g/t Au plus 0.15% Cu from drill hole BC-12-54. As corporate changes within Blue Gold finalize, future activities for the



property are uncertain. The area is underlain by Upper Triassic welded tuff, agglomerate lithic tuff, flows and breccias which have been intruded by an early Jurassic monzonite stock.

Teck continued exploration efforts at the **GJ** project (MINFILE 104G 034) as part of their option agreement to earn up to 75% of the project from partner NGEx Resources Inc. Located approximately 10 km west of highway 37 and 20 km west of Red Chris, similar geological models and exploration techniques are being used as those that discovered Red Chris. Exploration activities included 730 line km of ZTEM airborne geophysics, 10.4 line km of IP and magnetic geophysical surveys, 4000 m of diamond drilling, soil sampling, rock chip sampling and historic core re-logging (Figure 2.23). Drilling targeted coincident geological, geophysical and geochemical anomalies northeast of the known Donnelly zone (MINFILE 104G 086, 089). The drilling program comprised five holes at Wolf (MINFILE 104G 045), one at Seestor (MINFILE 104G 170) and two near the North zone (MINFILE 104G 180). Results are pending.

GJ is hosted in the early Jurassic (205.1 +/- 8 Ma) Groat stock which intrudes the Triassic Stuhini Group clastic and pelagic sediments. Faults of undefined geometry and displacement cut the Groat Stock leading to challenging exploration. It is notable that an angular unconformity (Figure 2.24) located approximately 2 km north of the Donnelly zone is interpreted to be the Triassic-Jurassic contact which is also reported to be exposed at Red Chris and near KSM and Brucejack.

Snip Gold Corp (formerly Skyline Gold Corp) completed a nine drill hole exploration program in the **Snip-Bronson Trend** gold-silver project area including work at the **Bronson Slope** gold-copper porphyry (MINFILE 104B 077) located adjacent to the past producing **Snip** gold mine (MINFILE 104B 250). A comprehensive review of all available data led to a proposed 5800 m drill program of which 2437 m was completed this year. Targets were strategically picked at the Snip-Bronson trend, Johnny Flats, the Burnie Trend and C1. The newly acquired Gorge zone, part of the Iskut Joint Venture agreement was also explored. In addition to drilling, borehole pulse electromagnetic (BPEM) geophysical surveys were completed in most of the 2012 drill holes and in four historical holes.

Mineralization occurs dominantly in conductive iron sulphides and BPEM has proved successful at identifying previously intersected gold-bearing mineralization. The goal of the this year's drilling program was to test grades of gold bearing structures as well as identify alteration and structure similar to that observed at nearby past producers. Significant gold grades were returned from all zones with highlights including 48.75 m grading 0.988 g/t Au and 7.5 g/t Ag from 18.0 m and 16.58 m grading 2.123 g/t Au and 4.4 g/t Ag from 115.52 m both in Gorge zone drill hole SG12-28. Results from 2012 activities are being compiled to prioritize targets for 2013.



Figure 2.23. Teck Geologists discuss recently drilled core from the Wolf prospect, located in the GJ project area.



Figure 2.24. An angular unconformity located approximately 2 km north of GJ's Donnelly Zone is interpreted to be the Triassic-Jurassic contact. This feature is also reported to be exposed at in the Red Chris, KSM and Brucejack areas.

Carmax Mining Corp released an updated resource estimate in May for the **Eaglehead** copper-molybdenite-gold porphyry (MINFILE 104I 008) located 48km east of Dease Lake. Inferred resources total 102.5 Mt grading 0.29% Cu, 0.010% Mo and 0.08 g/t Au. The resources are contained within two conceptual pits, the East zone and the Bornite zone. The updated resource is based on 8300 m of drilling completed in 2011 and historical drilling.

On December 11<sup>th</sup>, Hunter Dickinson Ltd daughter companies Amarc Resources Ltd and Quartz Mountain Resources Ltd commenced a drill program at the **Gnat Pass** copper porphyry prospect (MINFILE 104I 001) located approximately 26 km southeast of Dease Lake. A historical (1972) indicated resource estimate totals 30 Mt grading 0.39% Cu and is open to expansion. Drilling will target extensions to the historic resource and apply a more informed geological understanding of systems of this type such as the nearby Red Chris deposit. Drilling will continue through the winter.

TABLE 2.6. 2012 HIGHLIGHT WEST SEEL DRILL INTERCEPTS

Drill Hole	From (m)	To (m)	Width (m)	Cu %	Au g/t	Mo %	Ag g/t
<b>S12-101</b>	262	1079	817	0.2	0.21	0.026	2.24
<b>S12-104</b>	368	768	400	0.24	0.19	0.03	2.76
<b>S12-106</b>	120	892	772	0.23	0.14	0.028	3.31
<b>S12-108</b>	24	340	316	0.28	0.23	0.018	5.28
<b>S12-109</b>	262	554	292	0.23	0.21	0.03	2.8
<b>S12-118</b>	350	887	537	0.27	0.19	0.055	2.69
<b>S12-119</b>	234	807.7	573.7	0.24	0.13	0.026	2.62
<b>S12-121</b>	234	987.5	753.5	0.24	0.12	0.024	2.26
<b>S12-127</b>	248	688	440	0.22	0.13	0.015	3.13
<b>S12-130</b>	346	658	312	0.29	0.17	0.035	3.3

#### 2.4.1.2 Porphyry Copper-Molybdenum-Gold Projects in the Skeena Arch

Gold Reach Resources conducted a large drilling program at their 100% owned **Ootsa** copper-gold-silver-molybdenum porphyry project (MINFILE 093E 105) located 8 km southeast of the producing Huckleberry mine. The Ootsa project consists of three known deposits: Seel, West Seel and Ox. Drilling in 2012 totalled 45 147 m in 67 holes. Forty-six holes aimed to expand the West Seel zone, eighteen holes aimed to evaluate the Ox zone and three holes tested a large geophysical anomaly located 4.5 km northeast of the West Seel discovery.

A Seel deposit resource estimate released in January 2012, used drilling results acquired from 2005-2011 and applied a 0.2% copper equivalent cut-off. Indicated resources total 28.13 Mt grading 0.22% Cu, 0.21 g/t Au, 1.1 g/t Ag and 0.007% Mo. Inferred resources total 214.78 Mt grading 0.17% Cu, 0.13 g/t Au, 2.17 g/t Ag and 0.017% Mo. An updated resource will include 2012 drilling results and is expected to be released in early 2013. Mineralized intercepts over hundreds of meters been returned from 2012 drilling results, highlights are listed in Table 2.6 (above). Mineralization consists of quartz-biotite-feldspar porphyry with stockwork quartz veining and secondary biotite alteration hosts disseminated chalcopyrite and molybdenite (Figure 2.25).

New Nadina Explorations Limited has been financed by Australian based Intrepid Mines Limited to continue exploration at the past producing **Silver Queen** (MINFILE 93L 002) poly-metallic mine located 43 km south of Houston. Exploration targets are not testing the historic style of mineralization but rather the interpreted intrusive source named **Itsit**. Porphyry mineralization was first identified in 2011 drilling and geophysical

surveys. Follow up TITAN 24, direct current induced polarization (DCIP) and magneto telluric (MT) geophysical surveys totalled 21.6 line km early this year and were integral in generating high quality drill targets for the 2012 program. Due to overlapping land-use interests on the property, drilling operations were delayed until late November and will remain active throughout the winter (Figure 2.26). The proposed drill program consists of 5000 m and targets a generally east-southeasterly dipping chargeability anomaly associated with copper-gold-molybdenum bearing feldspar-porphyry intrusive. To date, two holes have been completed. Both have intercepted moderate to strong quartz stock-works with disseminated, fracture fill and massive pyrite and weak molybdenite mineralization (Figure 2.27). Textures in core are similar to copper-gold bearing core drilled in 2011. Results will be returned over the winter.

Lions Gate Metals Inc released an updated resource estimate for the **Poplar** copper-gold-molybdenum-silver project (MINFILE 93L 239) located 45 km southeast of Houston. Using 0.15% Cu cut-off grade, indicated resources now total 171.3 Mt averaging 0.28% Cu, 0.08 g/t Au, 2.3 g/t Ag and 0.008% Mo. Additional inferred resources total 209.0 Mt averaging 0.23% Cu, 0.06 g/t Au, 3.62 g/t Ag and 0.004% Mo. The resource update was largely based on 2011 drilling results and subsequently increased contained copper by 47%. In addition to the resource update, recommendations were made to further increase resource confidence and size, no exploration programs were implemented during 2012. Canadian Dehua International Mining Inc put forth an offer which has been accepted by Loins Gate executives and shareholders and will likely lead to significant activity in 2013.

Finlay Minerals Inc expanded their mineral tenure by 54% around their **Silver Hope** copper-gold-silver-

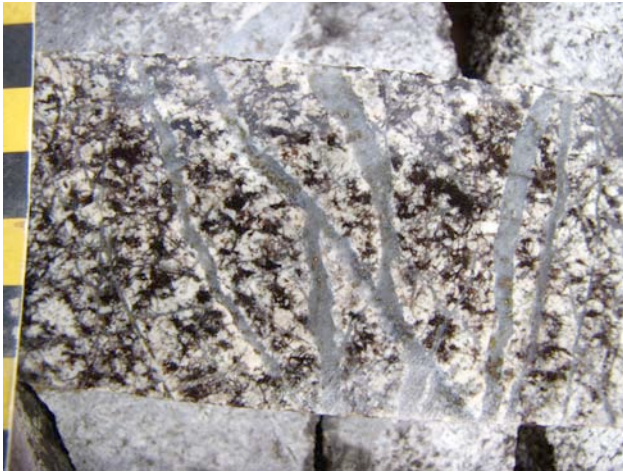


Figure 2.25. West Seel mineralization: quartz-biotite-feldspar porphyry with stockwork quartz veining and secondary biotite alteration hosts disseminated chalcopyrite and molybdenite.



Figure 2.26. Exploration drilling at the Itsit porphyry prospect resumed in late November. Due to overlapping land use interests, all drilling fluids are required to be contained and disposed of in the historic tailings impoundment area at the nearby Silver Queen mine.



Figure 2.27. Drill hole 12S-02; Itsit feldspar-porphyry with moderate to strong quartz stockwork similar in texture to gold-copper bearing core drilled in 2011.

molybdenum porphyry deposit (MINFILE 93L 256) totalling their holdings to over 97 km<sup>2</sup>. Although no drilling was completed this year due to funding restrictions, a property wide (of original tenures) airborne ZTEM geophysical survey was completed and produced multiple targets with a 5 x 7 km area. Follow up geological mapping, geochemical soil sampling and geophysical surveys are planned to generate prioritized drill targets.

Bearing Resources Ltd partnered with Eastfield Resources Ltd to conduct further exploration at the **Zymo** copper gold (MINFILE 92L 324) project located 45 km west of Smithers. Seven drill holes totalling 2322 m were spread between three targets: the FM zone (2 holes, 1 failed at 27 m), the RD zone (2 holes) and Hobbes zone (3 holes). Best results were returned from the Hobbes zone hole ZY12-32; 173.7 m grading 0.20 g/t Au and 0.26% Cu from 180.0 m. Additionally, hole ZY12-34 returned 297.0 m averaging 0.07 g/t Au and 0.12% Cu. Hobbes zone drilling this year improved the understanding of porphyry geometry by limiting the extent of mineralization to the east and extending weak to moderate copper mineralization to the west-southwest. The Hobbes zone was discovered in 2007 when a soil sampling program found copper bearing quartz-stock work hosted in diorite porphyry shown in Figure 2.28. Bearing Resources has given notice they will no longer be pursuing the option agreement with Eastfield to acquire interest in the Zymo property.

Riverside Resources Inc with strategic alliance partner Antofagasta Plc explored the **Lennac** (MINFILE 93L 190) and **Flute** copper-gold-molybdenite porphyry targets located approximately 55 km east of Smithers. A large airborne geophysical survey totalling 4532 line km produced detailed magnetic data reflecting lithologies and structure masked by pervasive till cover. Additional IP geophysical surveys were completed totalling 45.6 line km. Drilling followed up West and East zones at Lennac totalling 1485 m in 4 holes (two holes per zone). At the West zone, drilling targeted known mineralization to depth where previous drilling ended in mineralization at shallow depths. Results returned top to bottom low-grade copper mineralization in both holes (Figure 2.29) with local (up to 18.0 m) intervals grading up 0.401% Cu. Drill hole LLDH-12-001 returned 345.90 m grading 0.189% Cu, 0.033 g/t Au and 34.3 ppm Mo from 4.5 m. Drilling at the East zone targeted interpreted structure from magnetic data coupled with reverse circulation drill results, assays are pending.

#### 2.4.1.3 Nickel in Ultramafic Rocks

First Point Minerals Corp continued exploration for nickel-iron-alloy at the **Wale** and **Orca** prospects (MINFILE 104I 128) located 45 km and 34 km east of Dease Lake respectively. Rock chip samples returned from 2011 exploration at Wale defined the 3.6 km long



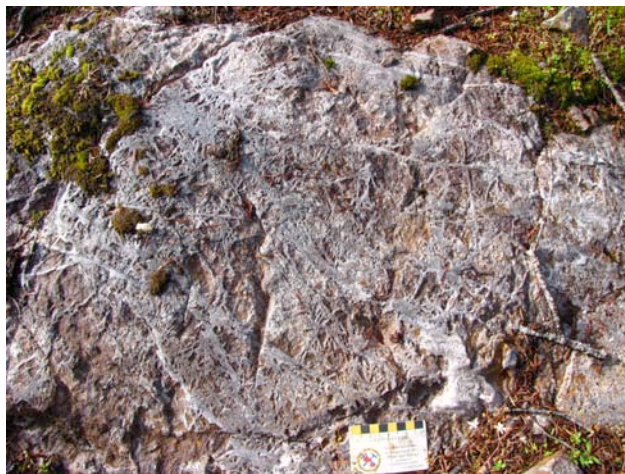


Figure 2.28. Copper-bearing quartz stockwork at the Hobbes Discovery showing on the Zymo property.



Figure 2.29. Drill hole LLDH12-002: Lennac Lake West zone drilling returned low grade copper values from surface to the end of hole.

Eagle target zone of nickel-iron alloy mineralization. Follow up 2012 activities included drilling, a five tonne surface bulk sample and ground-based magnetic geophysics. Drilling totalled 2 764 m in 10 diamond drill holes returning highlight results such as 260.7 m grading 0.126% nickel in alloy from 4.3 m in drill hole 12DH-06. The five tonne bulk sample was collected near the site of hole 1 where surface rock chips returned values from 0.150 - 0.164% nickel-iron alloy. The bulk sample material will be used for metallurgical test work as well as recovery investigations for iron and chromite. Exploration activities completed at Orca included rock chip sampling, mapping and ground magnetic geophysical surveys. The 1400 x 750 m Orca target zone is defined by 118 rock-chip samples averaging 0.113% nickel-iron alloy. Drilling is planned for 2013.

Awaruite ( $\text{Ni}_{2.3}\text{Fe}$ ) is hosted in serpentinized ultramafic rocks (Figure 2.30) of the Cache Creek Terrane. The mineral is integral to an emerging style of low-grade nickel deposit being evaluated by First Point and Cliffs Natural Resources at the advanced exploration stage Decar project located in the Omineca Region. Advantages of this deposit type are suggested through mechanical separation of awaruite grains using gravity and magnetic recovery methods versus sulphide flotation.

## 2.4.2 Massive sulphide projects

“Massive sulphide deposits in the Northwest region comprise of volcanogenic deposits, skarns, mantos, and some of undefined deposit type. Volcanogenic deposits occur in strata of varying ages and terrane affiliation. The Tulsequah Chief deposit is in Paleozoic strata; Kutcho Creek is hosted in early Triassic rocks, and important deposits in the Stewart district are hosted in Jurassic volcanic rocks. The latter include Eskay Creek, Granduc and Anyox. Manto and Skarn deposits occur where Paleozoic limestone of the ancient continental margin are intruded by Cretaceous to Tertiary plutons.” (Revised from Wodjak, 2010)

### 2.4.2.1 Stewart District

The **Red Mountain** copper-gold-silver property (MINFILE 103P 086) was reactivated when Banks Island Gold Ltd entered into an option agreement with Seabridge Gold Inc to acquire 100% of the property. Located approximately 18 km east of Stewart and extensively explored through the 1990's (Figure 2.31) including over 1600 m of underground development, the project has seen limited attention since 2000. Three months after Banks Island issued a Letter of Intent for Option of the Red Mountain property, they released an updated Preliminary Economic Assessment. Using historical data, an updated resource estimate was generated for four zones: Marc, AV, JW and 141. Measured plus indicated resources are reported from the all but the 141 zone and total 1.611 Mt grading 8.4 g/t Au and 38 g/t Ag. Inferred resources from all zones total 0.87 Mt grading 5.4 g/t Au and 10 g/t Ag. The PEA indicates an underground gold mine may be viable and recommends the project advance towards a pre-feasibility or feasibility study level. Proposed mine access would be via a +15% grade, 7190 m decline connecting the proposed mill site located at approximately 430 m elevation in the Bitter Creek valley to the deposits well over 1000 m vertically above.

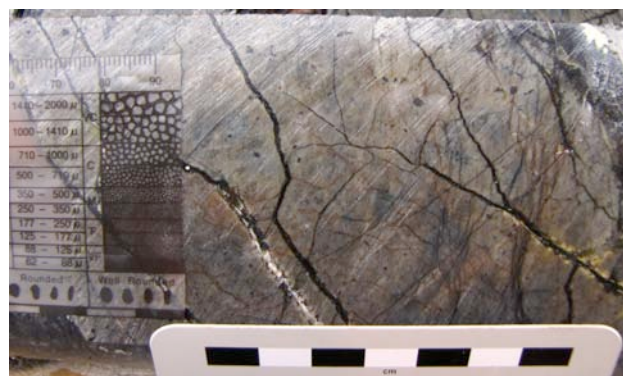


Figure 2.30. Millimetre-scale awaruite ( $\text{Ni}_{2.3}\text{Fe}$ ) hosted in serpentine at the Wale project.



Figure 2.31. Underground mining equipment left at Red Mountain from development completed in the 1990's.

While conducting ground work around the Red Mountain area, geologists identified a new showing approximately 3 km south of the known resource areas. Recent glacial retreat has exposed the valley floor approximately 880 m from the **MacAdam Point** poly-metallic showing (MINFILE 103P 220). Follow up prospecting identified an area approximately 1000 x 600 m exposing a quartz-monzonite – metasediment contact with a related metamorphic aureole. Grab samples from the contact associated polymetallic veins returned up to 71 g/t Au, 197 g/t Ag and 1.1% Cu. The new showing has been named **Lost Valley**.

Romios Gold Resources Inc. acquired additional tenures in the heart of the Golden Triangle resulting in continuous claims from their **Trek** (MINFILE 104G 022) porphyry copper-gold project to their **Newmont Lake** (MINFILE 104B 281) massive sulphide copper-gold-silver project. A review of all available data was conducted on the Trek property while most of 2012 efforts were concentrated on the '72, Ken and Northwest zones of the Newmont Lake project area. Activities at Newmont included diamond drilling and audio-magneto telluric geophysical surveys. Drilling totalled 2613 m in 15 holes in areas targeting both mineralization intercepted

in historic holes and extensions to known zones. Highlight returns from the Northwest zone include 11.35 m grading 3.99 g/t Au, 0.17% Cu and 2.36 g/t Ag in NW12-176 from 67.0 m which included discrete higher grade intervals up to 6.94 g/t Au over 1.85 m. At the Ken zone, drill hole KZ12-08 returned 3.28 m grading 1.39 g/t Au, 0.43% Cu, 5.34 g/t Ag and 8.30 g/t Sc from 47.11 m. Drill hole KZ12-12 returned a broad intercept of 105.57 m grading 0.40 g/t Au and 25.98 g/t Sc with minor copper and silver values from near surface (1.3 m). Massive sulphide mineralization at the Ken zone comprises of three horizons: the upper and lower gold zones and the scandium zone. Future exploration will follow up on 2012 drilling results and resistivity anomalies.

Dolly Varden Silver Corporation partnered with Hecla Mining to continue exploring the past producing Dolly **Varden** silver property (MINFILE 103P 188) located approximately 45 km southeast of Stewart. Hecla Mining secured a 19.9% interest in Dolly Varden Silver Corporation who is aiming to validate historic reserves and identify a new Eskay Creek type VMS deposit. Exploration activities included exploration drilling, geophysical surveys, geological mapping and sampling, access repair and some rehabilitation of underground workings. The entire proposed drilling program was not fully completed due to weather but still totalled 1728 m in 6 holes. The remainder of the drilling program is poised for an early start in 2013. An airborne geophysical ZTEM survey completed 733 line km.

Homestake Resource Corporation optioned their flagship **Homestake Ridge** gold-silver-copper project (MINFILE 103P 216) to Agnico Eagle who can now earn up to 65% interest in the project located 32 km north of Alice Arm. Drilling focussed on the South Reef zone and tested over 600 m of strike-length as well as other priority targets with 4743 m in 13 holes. Highlight results include 4.0 m grading 11.4 g/t Au and 3.7 g/t Ag from drill hole HR-243. The South Zone was discovered in 2011 and is located centrally in a 4 km long mineralized trend. The Main Homestake deposit is located approximately 800 m northwest of the South Reef (Figure 2.32) and contains an indicated resource totalling 0.88 Mt grading 6.7 g/t Au

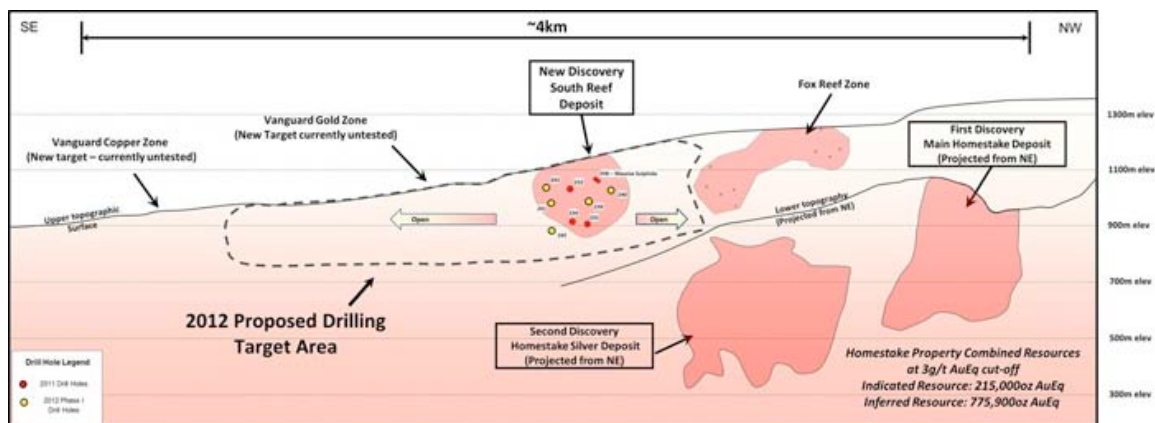


Figure 2.32. Homestake Ridge deposits long section looking southeast. Courtesy of Homestake Resources Corp.



and 47 g/t Ag using a 3.0 g/t gold-equivalent cut-off. Homestake Resource Corporation also completed ground work at their 100% owned **Kinskuch** project located immediately east of the Dolly Varden property. Rock and soil sampling followed up 2011 drilling and geophysics resulting in extending the overall silver-lead-zinc **Illiance River Trend** (MINFILE 103P 141) by 750 m. The geologic setting is interpreted to be similar to the past producing Dolly Varden mine.

## 2.4.3 Gold Silver projects

“Gold-Silver projects in the region targeted mainly orogenic and intrusion-related veins. In some cases veins have associated base metal values. Gold-silver projects occur in various geologic terranes and are currently concentrated in four areas: the ‘Golden Triangle’ (Stewart district) where most are related to Jurassic intrusions of Stikine terrane; the Atlin area where they are related to orogenic emplacement of Cache Creek terrane, and to the terrane-bounding Llewellyn fault; the Cassiar area where gold veins are related to orogenic emplacement of Slide Mountain terrane; and, the Skeena Arch where gold veins are mainly related to Cretaceous-Tertiary intrusions and secondarily to Cretaceous orogenic events.” (Revised from Wojdak, 2010)

### 2.4.3.1 Epithermal and Orogenic veins in the Atlin district

BC Gold Gold Corp now owns 100% of the historic **Engineer** underground gold mine (MINFILE 104M 014) located 32 km west of Atlin. The company has fulfilled its commitments to attain the final 25% of the project from Engineer Mining Corp as of September 25<sup>th</sup> and has entered into an agreement to acquire remaining site equipment, royalties and surface rights. Activities on site during 2012 included dewatering of levels 6 and 7 which have been submerged since mine closure in 1928. Ventilation and water services were restored allowing access to these levels. Geologists surveyed and sampled the down-plunge extent of the 505-3 and 505-5 gold shoots hosted within the Engineer Vein. One hundred ninety panel samples were collected along 74 m of vein exposure on 6 Level and along 173 m of vein exposure on 7 Level. Results of composite panel samples confirm moderate to strong gold values while high grade grab samples confirm local bonanza grades up to 12 720 g/t Au. It is notable that the 505-3 high-grade shoot is outside the 2011 inferred mineral resource. Surface activities included trench sampling along the 0.3-0.8 m wide, gold bearing, quartz-carbonate Schaft Vein located approximately 215 m northeast of the Engineer Vein. The Schaft Vein has been defined for over 50 m along strike and over 113 m below surface to the 5 Level and has returned bonanza grade grab samples but has never been drill tested.

Test mining of the Engineer and Decker veins in 2011 produced 246.1 tonnes grading 16.9 g/t Au and was milled on site. After milling and gravity concentration, (Figure 2.33) the bulk sample yielded 969.2 kg of dry concentrate averaging 2193.1 g/t Au. Eight hundred kilograms of that concentrate was sold to Sipi Metals Corp who then determined contained gold totalled 2177.5 grams of which 2112.2 grams were recoverable and payable to BC Gold Corp. Net proceeds from the bulk sample totalled \$107 000 USD. Further selective test mining is planned from Engineer Vein high-grade shoots accessible from the 6 and 7 Levels. Gold recovery from the on-site 30 tonne per day mill is currently estimated at 51%; bench-scale testing indicates recoveries above 70% are achievable.

Brixton Metals Corporation completed a successful exploration drilling program at the **Thorn** (MINFILE 103P 216) silver-gold-copper-lead-zinc project located approximately 130 km southeast of Atlin. Drilling totalled 2890 m and focussed on the Oban Breccia zone and returned high grade precious and base metal values. Best intercept to date was from THN12-84 (Figure 2.34): 310.0 m grading 105.82 g/t Ag, 0.71 g/t Au, 0.03% Cu, 0.90% Pb, 1.76% Zn from 26.0 m. Higher grade 123.0 m inclusion graded 190.68 g/t Ag, 1.19 g/t Au, 0.06% Cu, 1.26% Pb and 3.25% Zn from 44.0 m. An aggressive follow up program is being planned to ideally generate a maiden resource estimate in 2013.

### 2.4.3.2 Epithermal and Orogenic veins in the Cassiar district

China Minerals Mining Corporation completed drilling at the **Taurus** (MINFILE 104P 012) and **Table Mountain** (MINFILE 104P 070) past producing gold deposits now collectively known as the **Cassiar Gold** project. Infill drilling at Taurus tested gaps and surrounding areas of the Taurus deposit and the Sky Vein at Table Mountain. Forty-three holes totalling 6857 m



Figure 2.33. The gold line off the wash table at BC Gold Corp's Engineer gold mine. Courtesy of BC Gold Corp.





Figure 2.34. Drill hole THN 12-84: high grade polymetallic mineralization.

tested Taurus deposit targets. Highlight results include: TA12-11: 27.20 m grading 1.46 g/t Au from 104.60 m; TA 12-14: 4.7 m grading 12.32 g/t Au from 26.0 m; TA12-42: 36.15 m grading 1.17 g/t Au from 139.4 m. Drilling at the adjacent Table Mountain property on the Sky Vein totalled 1340m in 10 drill holes. Results returned higher gold grades from adjacent sericite – carbonate altered wall rocks than veins. Highlights include 12.50 m grading 1.91 g/t Au from 91.90 m from TM12-06.

#### 2.4.3.3 Epithermal and Orogenic veins in the Stewart District

Ascot Resources Ltd conducted a significant drilling program spread across three areas: the **Big Missouri** (MINFILE 104B 046), the **Martha Ellen** (MINFILE 104B 092) and the Sparky zone at **Dilworth**. The project area is located 13 km north of Stewart, immediately west of the past producing Silbak Premier gold mine (MINFILE 104B 054). Drilling totalled 36 942 m in 166 holes. A maiden resource estimate for the Big Missouri area utilizes drilling data from 2009-2011 was released in May. Using a 0.5 g/t Au cut-off grade, indicated resources total 25.19 Mt grading 1.224 g/t Au and 5.8 g/t Ag. Additional inferred resources total 19.95 Mt grading 0.881 g/t Au and 4.2 g/t Ag. Further exploration work is planned to ultimately relate proximal and historically significant Unicorn, S1, Dago, Northstar, Creek and Province / Big Missouri Zones (Figure 2.35).

Mountain Boy Minerals Ltd with joint venture partner Decade Resources Ltd drilled 73 holes at the past producing **Red Cliff** copper-gold-silver-zinc property (MINFILE 104A 037). Most of the drilling focussed on the **Montrose** zone (MINFILE 104A 033) approximately 1 km north of the historic Red Cliff underground workings and approximately 20 km north of Stewart. Drilling has returned multiple significant gold intercepts at proximal to historic workings including minor amounts of visible gold.

Teuton Resources remained active in the Stewart region by completing three drill holes at the **High** property (Figure 2.36) located approximately 57 km north of Stewart and on the southern margin of Pretivm

Resources' Brucejack project. Drilling totalled 1346 m with highlight results returning 222 m grading 0.88 g/t Au from drill hole H12-01. Teuton also drilled two holes at the **High South** property exploring for Eskay Creek style volcanogenic massive sulphide deposits. At the **Clone** gold project (MINFILE 103P 251), Canasia Industries collected 20 bulk samples weighing 1 tonne each. An average grade of the samples was 53.1 g/t Au.

#### 2.4.3.4 Intrusion Related Gold-Silver in the Skeena Arch

Argonaut Exploration Inc conducted exploration drilling at the **Victor Vein** located approximately 2.1 km south of the past producing **Columario** gold-silver mine (MINFILE 103I 077) and 17 km east of Terrace. Drilling totalled 725.4 m in four holes and confirms vein and mineralization continuity to the south. Highlight results include 1.2 m grading 11.5 g/t Au, 29.8 g/t Ag and 0.74% Cu. Argonaut has acquired mineral tenures covering several past producing precious metal mines including **Lucky Luke** (MINFILE 103I 039), **Cordillera** and **Dorreen** (MINFILE 103I 048). Ground work at Lucky Luke and Cordillera included prospecting and grab samples from dumps and veins which returned significant gold values up to 30.6 g/t Au, 274 g/t Ag and 10.5 g/t Ag. These gold properties have never been owned by a single company before now.

Eagle Plains Resources Ltd optioned the **Kalum** property (MINFILE 103I 225) to Clemson Resources Corp who can now earn up to a 60% interest in the project. Clemson drilled two holes aiming to extend mineralization from the **Bling-Rico** zone. Total drilling production and assay data were not available.

Exploration conducted by Amarc Resources Ltd focussed on silver and copper mineralization around the **MR** showing (MINFILE 093M 195) located approximately 55 km northeast of Smithers. Originally



Figure 2.35. Big Missouri and Dilworth projects in the background of the Long Lake Hydro project headworks.



Figure 2.36. Drilling at the High property involved over 2 km of water line.

discovered by Ralph Keefe in 1990 with the aid of a Provincial Government prospector's grant, the property has sat idle since exploration efforts ceased in 1992. Amarc has staked mineral claims over approximately 720 square kilometers of surrounding host rocks and geochemical anomalies and refer to the project area as **Silver Vista**. Activities this year included 2700 line km of airborne magnetic geophysical surveys, 700 geochemical silt samples, 6700 soil samples, 175 rock-chip samples and the re-logging and sampling of historic MR drill core. Results are being compiled over the winter and will be used to generate 2013 drill targets.

#### 2.4.4 Coal projects

Coal contributed 68% (\$5.85 billion) of estimated provincial mining revenues in 2011; re-evaluation of known coal deposits hosted in northwestern BC is gaining momentum. The former Mount Klappan project is now known as the **Arctos Anthracite** project (MINFILE 104H 022) and is owned by Fortune Minerals Limited (80%) and Posco Canada Ltd (20%) and located approximately 330 km northeast of Prince Rupert. There are four resource areas at Arctos, Lost Fox, Hobbit Broach, Summit and Lost Fox Extension deposits. Total measured plus indicated resources sum 231 Mt with additional 359 Mt of inferred resources. A Definitive

Feasibility Study (DFS) released in October 2012 and included updated drilling and survey data for the **Lost Fox** deposit area as well as defines an overall site proposal. Run-Of-Mine (ROM) proven plus probable coal reserves at Lost Fox total 124.9 Mt equating to 10% ash product reserves totalling 69.2 Mt. The DFS also assessed open pit mine development, a wash plant, site infrastructure and the costs to upgrade and extend rail service to the project site. Proposed production is 3 Mt per year of pulverised coal injection product to be transported by rail to the port of Prince Rupert. Capital expenditure for the project is an estimated \$788.6 million which includes full cost of the 150 km railway upgrade (estimated \$330 million) from the current terminus at Minaret. Estimated mine life is 25 years.

Coal at Arctos is high rank anthracite, desirable for particular steel-making purposes. The coal occurs within at least 33 individual coal measures up to 11 m in true thickness, 14 of which are considered amenable to open pit mining at the Lost Fox deposit with a minimum true thickness of 1 m. The deposits are hosted in the Jurassic through early Cretaceous Klappan Sequence of the Bowser Basin and part of the 30 x 80 km Groundhog Coalfield.

Atrum Coal is also evaluating coal resources in the southern region of the Groundhog Coal field at the **Groundhog** deposit (MINFILE 104A 078). Based on historical drilling and trenching, there are 8 economic coal measures between surface and 200 m depth. Additional coal seams at depth are possible. Atrum completed 15 drill holes totalling 4992 m and returned up to 36 m of cumulative coal between surface and 400 m and individually up to 8.2 m thick. Average cumulative coal seam thickness totalled 20 m from all 15 holes. Eight hundred coal samples were collected for coal quality analysis due by year end. A global JORC compliant indicated resource totalling 57.1 Mt with additional inferred resources totalling 101.9 Mt. Ninety per-cent of the updated resource is between surface and 150 m depth. An updated JORC resource estimate and mine scoping study are expected to be released in early 2013. Atrum is also reviewing all available data at the **Naskeena** coal project (MINFILE 103I 002) located 60 km north of Terrace. Interest has also been raised surrounding a review of available data and development options regarding the **Telkwa** coal measures (MINFILE 093L 152).

## 2.5 ACKNOWLEDGMENTS

This report is made possible by the openness and willingness of companies operating in northwestern BC. The overall amazing hospitality and helpfulness of mine staff, exploration geologists and prospectors is sincerely appreciated. 2012 was the authors first full year in the role of Regional Geologist and once again thank everyone for their patience as orientation takes place of this

geologically diverse and highly active area. Valuable assistance was provided by Paul Wojdak, Doug Flynn, Jill Pardoe, Bruce Graff, Savanna Levenson and the rest of the Smithers Mines Office, The Smithers Exploration Group, Regional Geologists Paul Jago, Bruce Northcote, Dave Grieve, Mineral Development Geologist Bruce Madu, Geological Survey Geologists, GIS support from Robin Chu. Errors or omissions remain the responsibility of the author.



# EXPLORATION AND MINING IN THE NORTHEAST REGION, BRITISH COLUMBIA

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## 3.1 SUMMARY AND TRENDS

Metallurgical coal is British Columbia's biggest export commodity, representing over 60% of mineral production in 2011. Metallurgical coke is a solid carbonaceous residue produced from low-ash, low-sulphur bituminous coal and is a key ingredient in steel production where it is used as a reducing agent in the smelting of iron in blast furnaces. As such, global economic trends in metallurgical coal reflect the state of manufacturing and construction sectors. The selling price of metallurgical coal fell from a peak of US\$300/tonne in 2011 to about US\$170/tonne in 2012. As an example of how this affected the Peace River Coalfield in the Northeast Region, Walter Energy Inc's metallurgical and PCI coal prices were down 12% and 15% in the second quarter forcing the company to reduce costs at its Canadian operations by \$14 per tonne. However, the medium-to-long term outlook for metallurgical coal remains positive based on forecast demand from Asia Pacific, primarily China, which is expected to drive global economic growth for the next 15 years despite a slowing domestic growth rate, according to Brad Johnston (General Manager Logistics, Teck Coal Ltd) who spoke at the 2012 BC Natural Resource Forum in Prince George.

Ridley Terminals, the main port servicing the Peace River Coalfield, is in the second year of an expansion project that will double the total annual terminal capacity to 24 Mt by the end of 2014. This expansion will accommodate rising export coal volumes from existing and new mines in Northeast BC. The Canadian National Railway prepared to build five long sidings in 2012 in the Edmonton-Prince Rupert corridor.

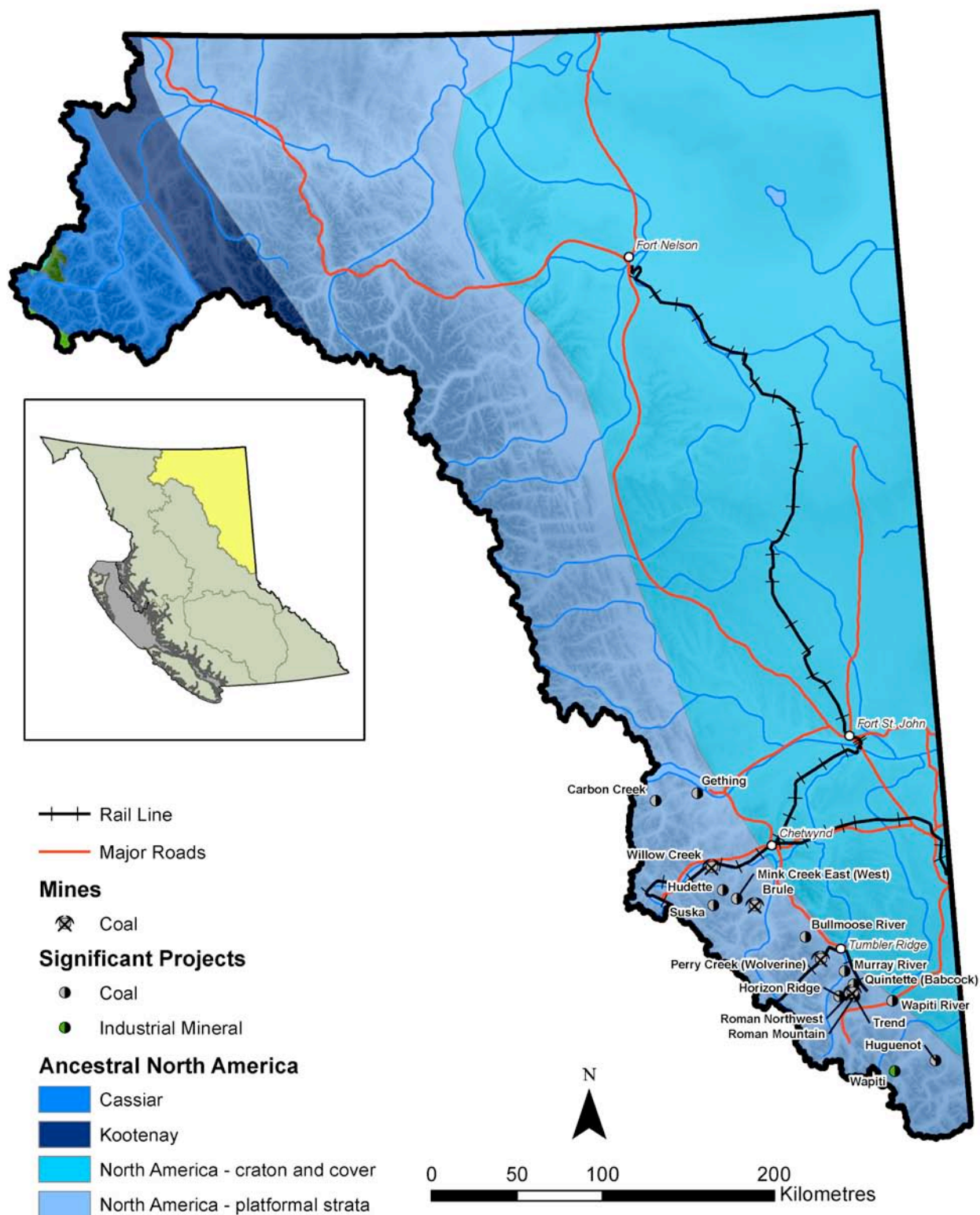
In the Northeast Region, 2012 was a record year for exploration investment and activity, due to continued mine development and exploration activity in the coalfield. Operating mines carried out expansion plans, and other projects moved toward opening new mines. As a result of increased investment from intermediate and major international companies, year-on-year exploration expenditure more than doubled (2.7 times) to \$109.3 million; and drilling metreage nearly doubled (1.8 times) to about 120 250 m. This made 2012 a record year for exploration investment and activity in the coalfield.

Exploration highlights included

- completion of Preliminary Economic Assessment (PEA) and Prefeasibility Study for **Carbon Creek** (Cardero Resources Corp);
- initiation of Prefeasibility Study at **Suska** (Xstrata Coal);
- initial stages of Surface Facility Area development and bulk sample excavation at **Murray River** (HD Mining International Ltd);
- update of resource estimate for **Huguenot** (Colonial Coal International Corp);
- drilling programs at **Bullmoose River** and **Wapiti River** (Canadian Dehua International Mines Group Inc ); **Gething** (Canadian Kailuan Dehua Mines Co Ltd ); **Carbon Creek** (Cardero Resources Corp); **Huguenot** (Colonial Coal International Corp); **Murray River** (HD Mining International Ltd); **Wapiti** (Homegold Resources Ltd); **Roman Mountain**, **Roman Northwest**, and **Horizon Ridge** (Peace River Coal Inc/Anglo American plc); **Quintette** (Teck Coal Ltd); **Mink Creek East**, **Mink Creek West**, **Hudette**, **Willow South**, and **Willow West** (Walter Energy Inc); **Suska** and **Sukunka** (Xstrata Coal).

### 3.1.1 Peace River Coalfield

The Peace River Coalfield of northeastern BC extends 360 km along the Northern Rocky Mountain inner foothills from 180 km east of Prince George at Coal Ridge to the Pink Mountain prospect, 130 km north of Hudson's Hope. Macroscopic scale folds and faults generally trend northwest-southeast. Medium- to low-volatile bituminous coal seams of economic thickness and continuity are hosted by the Lower Cretaceous Gething and Gates sedimentary formations. These are mined to produce hard-coking coal (HCC) and ultra low-volatile pulverized coal injection (ULV-PCI) products. PCI coal is a high-rank thermal coal used in blast furnaces for steelmaking. The HCC is internationally sought after for its coking strength under blast furnace conditions. Coals from both formations are relatively low in ash and sulphur, generally averaging 6-15% and 0.3-0.7%, respectively. Some Gething Formation seams have such low ash contents that the run-of-mine (ROM) coal doesn't require further processing. Seams from both formations typically yield low-ash washed coal product.



**Figure 3.1.** Mines and major exploration projects, Northeast Region, 2012.

### 3.1.2 Summary Figures and Tables

Figure 3.1 shows locations of mines and major exploration projects discussed in this report. Figure 3.2 provides a year-on-year comparison of exploration expenditures. Figure 3.3 sets out the approximate allocation of 2012 expenditures among Grassroots, Early stage, Advanced stage, Mine Evaluation, and Mine Lease exploration in the region. Figure 3.4 compares annual drilling statistics. Table 1 provides summary statistics for the producers, and forecast production. Table 2 lists details of the major exploration programs in 2012. Forecast total production for 2012 is about 5.5 Mt, similar to forecast production in 2011 (5.6 Mt), but greater than the reported 2011 production (3.7 Mt).

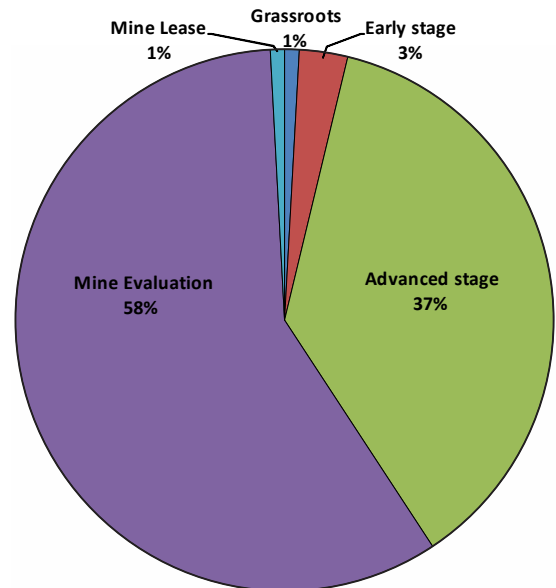
## 3.2 MINES

### 3.2.1 Coal

Four open-pit coal mines operated in the Northeast Region in 2012; the **Trend** mine of Peace River Coal Inc, wholly owned by Anglo American plc (Anglo/PRC); and the **Perry Creek** (Wolverine), **Brule**, and **Willow Creek** mines of Western Coal Corp, wholly owned by Walter Energy Inc (WEWC). The latter two operations also produce semi-anthracite ULV-PCI thermal coal in addition to bituminous coal of metallurgical quality.

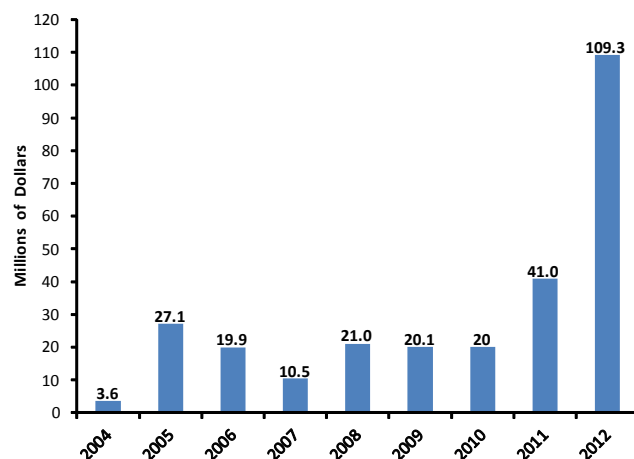
#### 3.2.1.1 South of Tumbler Ridge

Mining continued in Phases 2, 4, 5, and 6 at the **Trend** mine of PRC/Anglo, 25 km south of Tumbler Ridge (Figure 3.5). Production was an estimated 1.4 Mt ROM coal, and 1 Mt washed coal product. With ongoing development to the southeast, and addition of the Roman Mountain expansion (see below), salable tonnage is expected to increase to 2.5 Mt by 2016, and to 4 Mt with the implementation of the Phase-2 mine plan. Reserves are estimated at 22.6 Mt ROM coal (Proven and

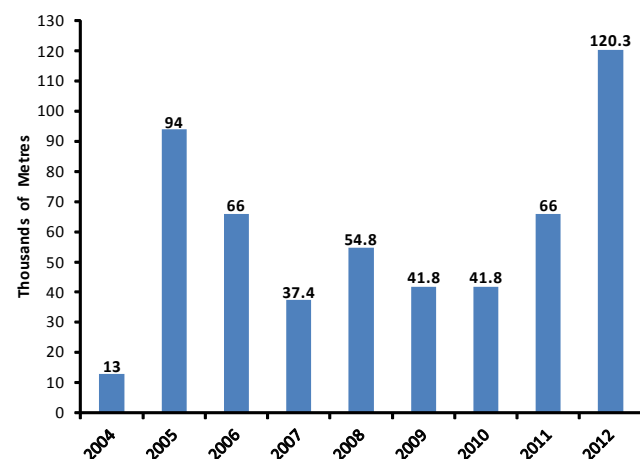


**Figure 3.3.** Exploration expenditures in 2012 by exploration stage (Grassroots: initial reconnaissance; Early stage: focused work on a target; Advanced stage: resource delineation, PEA and Prefeasibility; Mine Evaluation: focus on EA certificate, Feasibility studies, social license and government approval; Mine Lease: on-lease infill and mine development exploration). Year-on-year, the combined Grassroots/Early stage categories increased by 4%, the Mine Evaluation stage increased by 20%, the Advanced stage decreased by 14%, and Mine Lease decreased by 10%.

Probable), with an additional in-situ mineable resource of 21.2 Mt (Measured and Indicated) and 1.4 Mt (Inferred). South of Babcock Creek, Phases 1, 2 and 3, began in 2006, 2008, and late-2010 respectively. Farther south along strike of the Waterfall Anticline, Phases 4, 5 and 6 have been exhaustively explored and fully permitted. Mining is expected to continue for about another 10 years. Anglo views the mine as an external coal source to buffer against potential supply shortfall in Australia from flooding or labour issues.



**Figure 3.2.** Annual exploration spending estimates in millions of dollars, Northeast Region (amount for 2010 is a rough estimate).

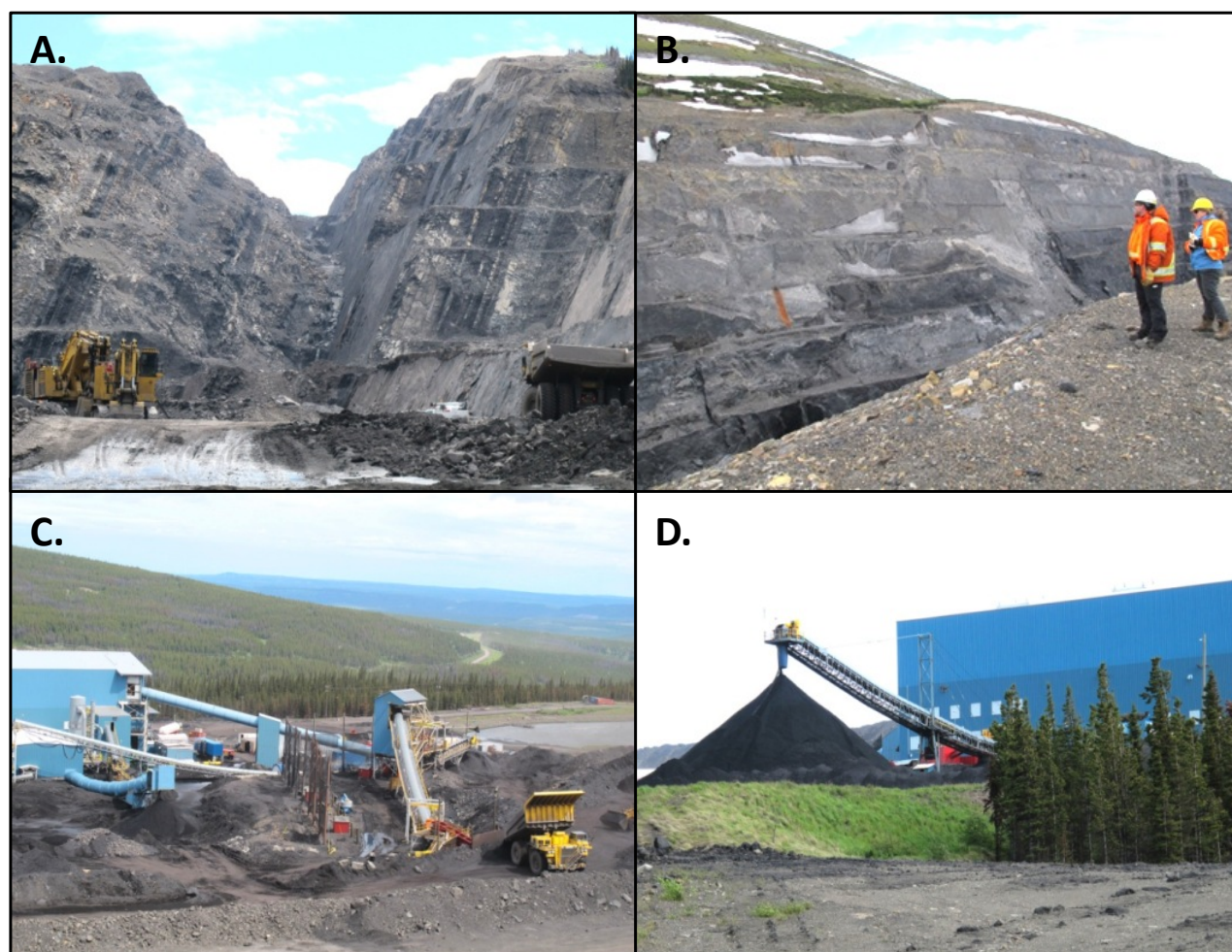


**Figure 3.4.** Annual exploration drilling estimates in thousands of metres, Northeast Region (amount for 2010 is a rough estimate).



**TABLE 3.1. FORECAST MINE PRODUCTION AND RESERVES, NORTHEAST REGION, 2012**

Mine	Operator	Deposit Type/ Commodity	Actual Washed Coal Production in 2011 (Mtonnes)	Targeted Washed Coal Production in 2012 (Mtonnes)	Proven and Probable Reserves, Mtonnes ROM (effective date)	Measured and Indicated Resource, Mtonnes in- situ mineable inclusive of Reserves (effective date)
Brule	Walter Energy Inc (Western Coal Corp)	ULV-PCI	1.1	1.8	21.1 proven (Dec 31, 2011)	33.6 (Aug 31, 2010)
Perry Creek (Wolverine Project)	Walter Energy Inc (Western Coal Corp)	Hard coking coal (HCC)	1.1	1.8	12.9 proven (Dec 31, 2011)	28.0 (Aug 31, 2010)
Trend	Anglo American plc (Peace River Coal Inc)	Hard coking coal (HCC)	0.9	1.0	22.6 (Dec 31, 2011)	43.8 (Dec 31, 2011)
Willow Creek	Walter Energy Inc (Western Coal Corp)	ULV-PCI, HCC	0.6	0.9 (0.6 PCI, 0.3 HCC)	19.9 (Dec 31, 2011)	51 (Aug 31, 2010)



**Figure 3.5. Trend Mine** – **A.** Phase-1 looking southeast toward Phase-2. Seams A to J in northeast limb of anticline; **B.** Looking at oblique fault intersection with J-seam footwall in Phase-3; **C.** ROM stockpile and wash plant; **D.** Washed coal stockpile ready for trucking to loadout facility.

Hard-coking coal of medium-volatile bituminous rank is being mined from the Lower Cretaceous Gates Formation (D, E, F, G, I, J, and K seams) along the northeast limb of a tight upright fold the Waterfall Anticline. Stratigraphy is continuous in the area with good correlation of coal seams. Cumulative coal thickness is about 16.5 m, excluding the K-seam. Structurally variable seams of the Lower Cretaceous Gething Formation (Bird and GT seams) are also present and can be blended with Gates Formation coals. ROM coal has a 20% ash content that washes to an 8.5% ash coal.

### 3.2.1.2 Wolverine Valley area

The **Perry Creek** mine (Wolverine Project) of (WEWC), 18 km west of Tumbler Ridge, was the company's foremost revenue generator in 2012 (Figure 3.6). Mining operations continued along the axial surface of the Perry Syncline in Phases 3A and 3B, which have been mined at different rates to provide feed to the processing plant and are now offset within the pit. Midway through the year, mining began on Phases 4A and 4B on the gently-dipping southwest limb of the syncline. Stripping of overburden for Phase 4A was at the 1185 m level in late June, with the targeted coal sequence beginning at the 1098 m level, and stripping is expected to continue into January 2013. A 150 m pushback of the highwall is also being investigated as Phase-5, tentatively scheduled for 2018-2019. The average strip ratio for the entire mine is 14:1, with a 1:1 strip ratio in Phases 3A and 3B. Expected production is currently 1.8 Mt washed coal, but the mine is permitted to produce up to 3 Mt/y and has a 3.5 Mt/y loadout facility. The estimated resource is 28.0 Mt in situ mineable coal (Measured and Indicated) including 12.9 Mt ROM coal reserves (Proven). Mining is expected to continue to 2019.

HCC of medium-volatile bituminous rank is being mined from the Lower Cretaceous Gates Formation (E2, E3, F, G, J1, J2, J3 seams in descending order) in the Perry Syncline. The 3-plied basal J-seam comprises about 7 m coal thickness, while the remaining seams are average 1 -2.5 m. The J-seams are split by a transgressive lag conglomerate that thickens to the north and east. These seams are easier to mine and process but make softer coking coal, which requires blending with upper seams or Willow Creek coal for the final HCC product. The F-seam also underlies conglomerate and requires precise blasting when mined.

### 3.2.1.3 Chetwynd-Pine River Area

The **Brule** mine of (WEWC) is 37 km south of Chetwynd in the larger Brazion Group of properties that includes **Willow Creek** (Figure 3.7). Mining continued in the Brule Pit in 2012, where the 'Camp pit' phase was completed in September. Phase 2 continued to



**Figure 3.6. Perry Creek Mine – A.** Digging to access G-seam in Phase 3B; **B.** Preparing to blast in Phase 4A.



**Figure 3.7. Brule Mine – A.** Visitors view the Hitachi EX8000 shovel on a tour of WEWC's Brule mine as part of the NE BC Coal and Energy Forum, Oct 9 2012; **B.** Hauling a load from Phase 2 of the Brule pit.



the northwest and north with a strip ratio of 10:1. Mining will resume in the original Dillon and Blind pits for four months in 2013 to capture the dump space profile at a strip ratio of 2:1. Current production is 1.8 Mt/y, with a capacity increase to 2 Mt/y expected with improvement programs and equipment upgrades. The estimated resource is 33.6 Mt in-situ mineable coal (Measured) including 21.1 Mt ROM coal reserves (Proven). Mine life is estimated for another 10 years to 2022. The transition from mine-contractor to in-house operation is underway.

The mine produces ULV-PCI coal from three Gething Formation seams within the Owl Creek syncline. Cumulative coal thickness is about 12 m. The Upper 60 seam goes to the wash plant, whereas the Upper and Lower seams need no processing and go directly to loadout. ROM coal is trucked 60 km on the Falling Creek Connector Road to the processing plant and rail loadout facility at the Willow Creek mine.

The **Willow Creek** mine is 38 km west of Chetwynd in the Pine Valley area (Figure 3.8). Mining continued in 2012 at Willow North in the 7N1 and 7N2 pit areas, and in the new 4N1 development area. Production was limited in the first quarter by a scheduled wash plant outage to upgrade HCC processing efficiency. A new rotary breaker was installed at the processing plant in March. The operation also transitioned from a contractor-operated to an owner-operated mine, successfully retaining about 90% of the workforce. Production is targeted at 0.9 Mt, with one-third HCC and two-thirds ULV-PCI coal, and is planned to increase to 1.2 Mt

in 2013. The mine is permitted to produce up to 1.7 Mt/y. The estimated resource is 51.0 Mt in-situ mineable coal (Measured and Indicated), including 19.9 Mt ROM coal reserves (Proven and Probable). Mining is expected to continue another 15 years to 2027. Willow Creek coal at a higher CSR (Coke Strength after Reaction) is marketed at a premium separately from Wolverine project coal. Both Willow Creek and Brule (Upper 60 seam) ROM coal is processed at the Willow Creek site.

Nine economic coal seams (youngest to oldest: numbered 1 - 4, A, 5 - 9) of the Gething Formation occur on the east limb of the 4-km long Pine River anticlinorium and its disharmonic subsidiary synclinal folds. The coal seams are commonly split, with coal units averaging 1.2 m thickness, and a cumulative thickness of about 29 m. Three seams (5, 7, and 8) are ULV-PCI coal. Folding and faulting are more complex in the Willow South area.

### 3.3 MINE EVALUATION

#### 3.3.1 Coal Projects

##### 3.3.1.1 South of Tumbler Ridge

The **Belcourt-Saxon** joint venture project of the Belcourt Saxon Coal Ltd Partnership, Anglo/PLC (50%) and WEWC (50%), was idle again in 2012. A significant exploration program at **Belcourt North/South** was delayed because of permitting issues. A 2009 Anglo/PLC technical report on Belcourt North and South estimates 86.4 Mt in situ reserves (Proven and Probable), and a 171 Mt resource (Measured and Indicated). As of Dec 31, 2011, Walter Energy Inc reported 28.5 Mt reserves (Proven and Probable) for the **Saxon** properties, classified as Prefeasibility, and the resource has historically been reported at 327.5 Mt (Indicated) and 98.6 Mt (Inferred). Phase-1 of the Bel-Sax project, expected to start by 2020 at Belcourt, could have production of 4 Mt/y and be viable for 40 years. Six economic Gates Formation coal seams at Belcourt North average 19.0 m total thickness, and seven seams at Belcourt South average 13.5 m thickness. Structurally, the deposit sits in a northwest trending band of thrust faulted, tight-to-open subsidiary folds along the northeast limb of the Belcourt anticlinorium (Belcourt North), and in an open synclinal structure called the Holtslander synclinorium (Belcourt South). The combined Bel-Sax project extends northwest from the Alberta border for about 70 km.

Anglo/PLC's expansion projects near the **Trend** mine are part of a development plan that includes an initial increase in combined washed coal tonnage to 2.5 Mt by 2016, and a further increase to 4 Mt in Phase-2.



**Figure 3.8. Willow Creek Mine** – A. View west to 7N1 pit area; B. Mining in 7N2 pit area, 1082 bench.



**TABLE 3.2. MAJOR EXPLORATION PROJECTS, NORTHEAST REGION, 2012**

<b>Property</b>	<b>Operator</b>	<b>Minfile (NTS ref)</b>	<b>Commodity</b>	<b>Deposit Type</b>	<b>Work Program</b>
Bullmoose River	Canadian Dehua International Mines Group Inc / Canadian Bullmoose Mines Co Ltd	(093P.003,004,006)	metallurgical coal	sedimentary	A, DD (14 171 m), EN, FS
Carbon Creek	Cardero Resources Corp	093O 028, 094B 022 (093O.097, 094B.007)	metallurgical coal	sedimentary	A, CQ, CT, DD (5600 m), EN, RC (3335 m), PEA, PF, FS
Gething	Canadian Kailuan Dehua Mines Co Ltd	093O 030 (093O.098, 099; 094B.008, 009 )	metallurgical coal	sedimentary	A, GD (1770 m), EN, FS
Horizon Ridge	Anglo American plc (Peace River Coal Inc)	093I 032 (093I.085)	metallurgical coal	sedimentary	A, DD (7040 m), TR
Hudette	Walter Energy Inc (Western Coal Corp)	(093O.050)	metallurgical coal	sedimentary	A, CQ, DD (8262 m)
Huguenot	Colonial Coal International Corp	093I 014 (093I.049, 059)	metallurgical coal	sedimentary	CQ, DD (1900 m), EN, RC (500 m)
Mink Creek East	Walter Energy Inc (Western Coal Corp)	(093P.041)	metallurgical coal	sedimentary	A, CQ, DD (3720 m)
Mink Creek West	Walter Energy Inc (Western Coal Corp)	(093P.041)	metallurgical coal	sedimentary	A, CQ, DD (3500 m)
Murray River	HD Mining International Ltd	093I 010 (093P.005, 093I.095)	metallurgical coal	sedimentary	A, BU (100 000 tonnes), DD (375 m), EN
Quintette	Teck Coal Ltd	093I 011 (093I.095, 096)	metallurgical coal	sedimentary	A, CD, CQ, DD (7140 m), EN, GD (300 m)
Roman Mountain	Anglo American plc (Peace River Coal Inc)	093I 030 (093I.086)	metallurgical coal	sedimentary	A, DD (9282 m), TR
Roman Northwest	Anglo American plc (Peace River Coal Inc)	(093I.014, 015)	metallurgical coal	sedimentary	A, DD (4397 m), TR
Suska	Xstrata Coal	093O 050 (093O.049)	metallurgical coal	sedimentary	A, CQ, DD (5000 m), EN, GD (600 m), RC (16 000 m)
Wapiti	Homegold Resources Ltd	093I 008, 022 (093I.047)	upwelling phosphate	sedimentary	A, G, GC (rock), DD (200m), P, TR

Table 2 continued on following page

TABLE 3.2 (CONTINUED)

Property	Operator	Minfile (NTS ref)	Commodity	Deposit Type	Work Program
Wapiti River	Canadian Dehua International Mines Group Inc	093I 013 (093I.009, 010, 015, 016)	metallurgical coal	sedimentary	A, DD (20 921 m), EN
Willow South	Walter Energy Inc (Western Coal Corp)	093O 008 (093O.069, 059)	metallurgical coal	sedimentary	A, CQ, DD (3575 m)
Willow West	Walter Energy Inc (Western Coal Corp)	093O 008 (093O.060)	metallurgical coal	sedimentary	A, DD (2676 m)

**Work Program Abbreviations:**

A = access (trail, road construction on claims); BU (X tonnes) = bulk sample (weight in tonnes if known); CD = condemnation drilling; CQ = coal quality testing; CT = carbonization test (coal); DD (Xm) = diamond drilling (totalling X metres); EN = environmental baseline studies/monitoring, remediation work; FS = Feasibility studies; G = geology, mapping, etc.; GC = geochemical sampling (rock, silt, soil, etc.); GD = geotechnical drilling; P = prospecting; PEA = Preliminary Economic Assessment, scoping study; PF = Prefeasibility studies; R = reclamation; RC = reverse circulation drilling; TR = trenching

The **Roman Mountain** project sits in a tight syncline (Murray Syncline) 1 km southwest of Trend mine (Figure 3.9). The syncline has a 4 km strike length, is cored with Gates Formation conglomerate and coal seams, and features steep reverse faults with associated folds and tectonically thickened coal. A trenching and drilling program was permitted in September to delineate coal seam repetition, upgrade Gething Formation seams on either fold limb, and provide better coal quality data using PQ air-coring and triple-tube system to maximize core recovery. Caribou mitigation and monitoring plans were revised over the year to coincide with the PCNP interim guidelines. The planned contour mine, with an expected 15-year life and annual production of 2.5 Mt, will encompass both limbs of the syncline. The current in situ mineable resource is 26.7 Mt (Measured and Indicated). A suspension on the 2009 Environmental Assessment (EA) application was lifted in April, and a decision is expected by the end of 2012.

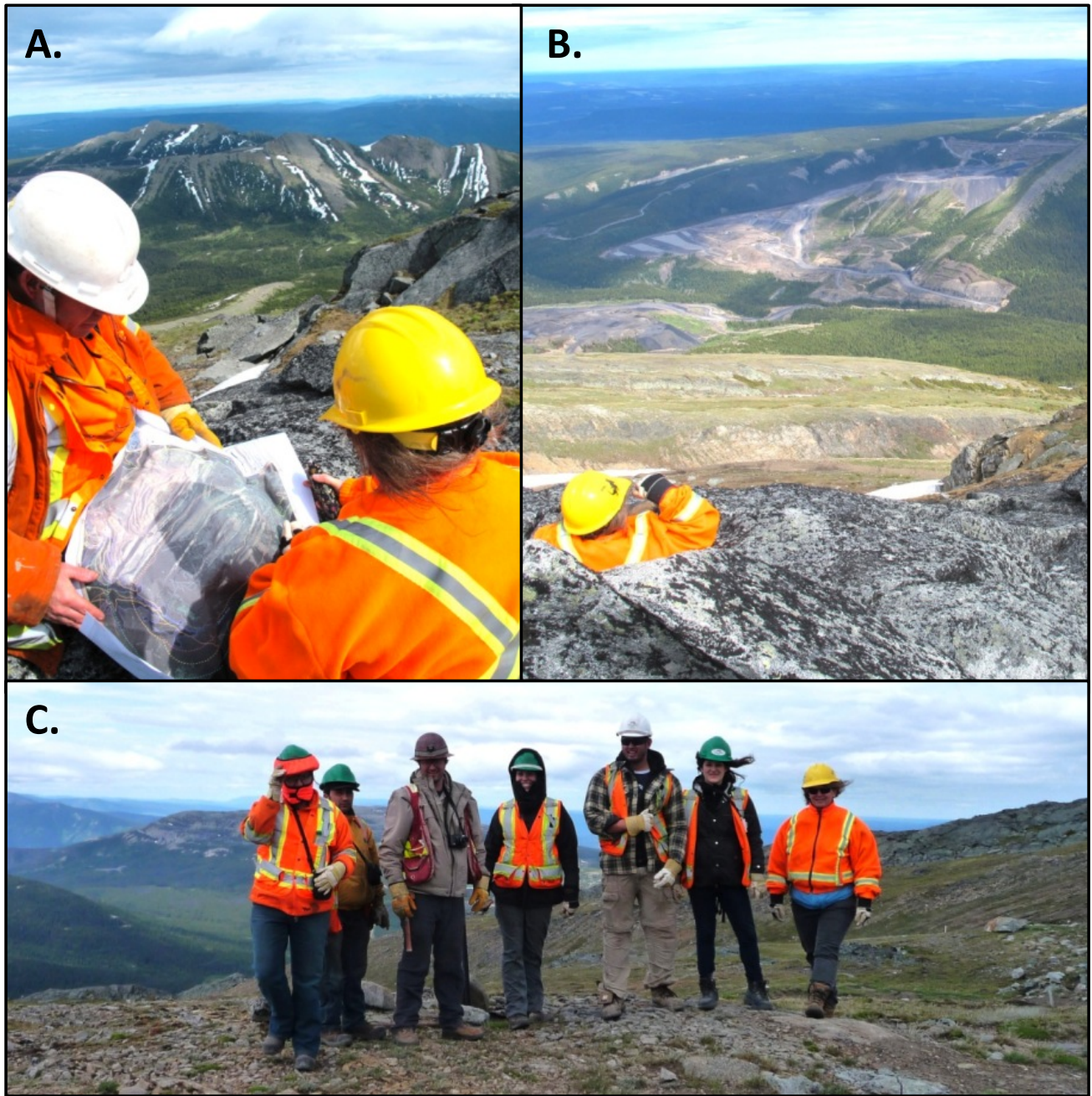
Other Anglo/PRC expansion projects include **Roman Northwest** and **Horizon Ridge**. Both projects have approved drilling and trenching programs. **Roman Northwest** is 4 km northwest of Roman Mountain on Mt. Kostuik. A new geological interpretation suggests the deposit sits within a tight chevron fold sequence. The **Horizon Ridge** project (formerly the Five Cabin Coal Project), 8 km west of the Trend Mine, sits in a broad asymmetric syncline containing both Gates and Gething coal seams with potential for a 1.6 Mt /y underground operation over 20 years. The project is in the Pre-Application stage of the EA process.

Restart of the Teck's **Quintette** mine project, 20 km south of Tumbler Ridge, remained on hold awaiting a Mines Act Permit Amendment (MAPA) and a First

Nations third party review (Figure 3.10). The mine operated from the early 1980s until August 2000. The new mine plan, based on a 2010 Feasibility Study and new geological interpretation, is focused on reopening the Windy and Window pits on the northwest and northeast sides of Babcock Mountain. By maximizing the use of existing infrastructure and processing plant, the mine is expected to produce between 3 - 3.5 Mt of washed coal annually over a 15 - 17 year mine life, employing 500 people. The MAPA was submitted for pre-screening in April, the Feasibility Study was submitted for review in September, and a final caribou mitigation plan was submitted to the Province in October. Production is anticipated for 2013, depending on a positive Feasibility decision. New mining equipment, breaker station, service truck shop, facility refurbishment, and accommodations are required.

This summer, the development program at Quintette included geotechnical drilling, installation of groundwater wells, trail construction, and drilling on Mt. Babcock to define coal seam characteristics, and to conduct subsurface foundation investigations. The program was run from Aug 1 to Oct 31, during the caribou low-risk timing window. Dismantling and stockpiling of the old 13 km conveyor from the Mesa Pit is completed. The estimated resource is 180.5 Mt (Measured and Indicated), and 136.5 Mt (Inferred) of raw coal. Babcock Mountain is a box-fold in the Waterfall anticline trend, having a coal sequence similar to that of the Trend mine (D to K seams).

Ten km southwest of Tumbler Ridge at the **Murray River** project, HD Mining International Ltd (a joint venture of Dehua and Huiyong Holdings Group) initiated



**Figure 3.9. Roman Mountain** – A. Geologist David Thompson and BC Senior Minerals Coal Geologist Janet Riddell getting oriented on Roman Mountain; B. Janet looking east from Roman Mountain at Trend Mine Phases 4-6; C. Team of Anglo/PRC Geologists with Janet Riddell and BC Regional Geologist Paul Jago on Roman Mountain (photo by David Thompson).

the excavation of a 100 000 tonne bulk sample as part of their Surface Facility Area development program (Figure 3.11). The Surface Facility includes a North Shaft Site and a South Decline Site. Development work included the completion of two settling ponds and accessorial discharge systems, a waste rock facility at the north site, a steel bridge structure for the decline portal, geotechnical drilling in the proposed portal location, and hydrogeological drilling in the proposed area for coarse coal rejects and wash plant. The company plans a dual shaft method for the underground longwall mining operation, wherein a large-diameter vertical shaft up to

11.5 m wide intersects a 5 x 5 m decline shaft grading at 16° to a depth of 500 m. The vertical shaft will provide ventilation and access for workers and equipment. The decline shaft will house a 1600 m conveyor. Coal seams are expected at depths between 500 m to over 1000 m. Construction is targeted for completion by 2014. Production is estimated at 6 Mt/y over a 31 year mine life. Reserves are reported at 789 Mt of proven deposit, and the resource at 3180 Mt (Inferred). The project is in the Pre-Application stage of EA, and baseline studies are underway. An initial workforce of 201 Huiyong Holdings miners was approved by Human Resources and Skills





**Figure 3.10. Quintette** – View of Mt. Babcock from 5 km to the south on Roman Mountain.



**Figure 3.11. Murray River** – **A.** Stripped and graded North Shaft site with soil stockpile and Quintette Mine in the background 3 km to the southeast; **B.** HD Mining Engineers discuss North Shaft site with Janet Riddell.

Development Canada (HRSDC) under the Temporary Foreign Worker Program. Seventeen workers arrived by late November and 60 more were scheduled to arrive in December. In late November the company announced a \$15 million housing project in Tumbler Ridge linked to the proposed mine, and signed an MOU with Northern Lights College to develop a curriculum to train Canadian workers in the longwall mining method. A 1981

Quintette Coal Ltd report on the area describes a northwest-trending asymmetrical syncline-anticline pair called the Shikano structure, and a secondary fold pair called the M-9 extension. Minor thrust faults related to folding are present. Six continuous Gething Formation coal seams (D, E, F, G, J, and K) with dips generally ranging from 15-40° have an average combined thickness of 17.9 m.

### 3.3.1.2 Wolverine Valley area

WEWC's Wolverine Project in the Perry Creek/Mast Creek area includes the **EB (Mt. Spieker)** and **Hermann projects**. Exploration has been completed in both these areas; Hermann is in the Prefeasibility stage, whereas EB is a development project. Both have approved EA Certificates. The EB pit design was being reassessed/expanded at a higher coal price in 2012. Production of 1 Mt/y is expected with mine life of 10 years (at EB) and 5-10 years (at Hermann). As of Dec 31 2011, estimated reserves were 9.9 Mt ROM coal (Proven) for EB and 9.1 Mt ROM coal (Proven and Probable) for Hermann. Production could commence at EB as early as 2013 and before 2019, and Hermann will follow with mining anticipated to continue past 2030.

In November, Hillsborough Resources Ltd and partner Vitol Ankor International B.V. submitted a revised Project Description to the EA office for the **Echo Hill** (formerly **Wapiti**) thermal coal project, 36 km northeast of Tumbler Ridge. An earlier proposal for a combined mine and 184-MW electric power plant operation was dismissed after the 2007 Provincial Energy Plan required new electricity sources to have “net-zero” greenhouse gas emissions. The new \$35 million proposal is for a contour highwall and auger mining operation with 1 Mt/y production of thermal coal for the Asian market. Hillsborough anticipates a mine life of 10 - 14 years which will provide 120 local jobs. The power generation component to the project has been dropped. A resource estimate of 80.1 Mt (Measured and Indicated) and 35.2 Mt (Inferred) was provided in a 2007 technical report. The project is currently in the Pre-Application stage of the EA process. Three coal seams occur in the 460 m thick Upper Cretaceous Wapiti Group. A series of northwest-trending open folds are present as are small-scale subsidiary folds and two high-angle thrust faults. A single flat-lying coal seam underlying local mesas is targeted for the mining operation. In late 2011, the company established a long-term services agreement with Ridley Terminals (until the end of 2021).

### 3.3.1.3 Hudson's Hope area

In June 2011, Cardero Resources Corp acquired Coalhunter Mining Corp, and the advanced-stage **Carbon Creek** project, 48 km west of Hudson's Hope (Figure 3.12). Coalhunter was renamed Cardero Coal Ltd, a wholly owned subsidiary, and remains operator of the





**Figure 3.12. Carbon Creek – A.** Orofino Drilling Ltd drill using HQ3 system; **B.** Cardero geologists in core shed reviewing drill logs with Janet Riddell; **C.** Gething Formation coal seam no. 31 in core.

project. In January, Cardero Resources Corp (75%) and the Carbon Creek Partnership (25%) released a PEA study, followed by a Prefeasibility study in September. The PFS significantly upgrades reserves and resource to 121 Mt (Proven and Probable) and 468 Mt (Measured and Indicated), and proposes a combined surface and underground (room-and-pillar) operation with average annual production of 4.1 Mt washed coal over an initial 20 years. The operation will be divided into a Central Surface Mine and North Mine areas. Products will be 60% HCC, 34% PCI and semi-soft coking coal, and 6% oxidized thermal coal. Cardero proposes to transport washed coal by 15-17 Kt payload barge on Williston Lake from Carbon Inlet to Mackenzie for rail load-out. First production is planned for fourth quarter 2014, with a projected 876 jobs. The mine will be unique in the region as the plant design does not require a tailings impoundment, as the waste rock will be sufficiently soft to compress and add to coarse coal rejects. The 2012 exploration program included: resource and expansion drilling; large-diameter drilling for coal quality; and geotechnical, hydrogeological, and gas desorption test work. It was the last major program prior to completion of a Feasibility Study in 2013, followed by a Mines Act Permit Application. The project is in the Pre-Application

phase of the EA process. In May, the company announced a 15 year shipping agreement with Ridley Terminals starting in 2014. The property consists of a gentle doubly-plunging syncline between two anticlinal belts. Minor folds are associated with steep thrust faults. Over 30 Gething Formation coal seams have been identified on the property, with 16 economic seams averaging 1.5 m thickness. The deposit shows good continuity and simpler geometry than many other deposits in the coalfield.

At the **Gething** property of Canadian Kailuan Dehua Mines Co Ltd, 25 km west of Hudson's Hope, a 30-hole geotechnical drilling program was conducted to identify ground conditions and geotechnical constraints for the engineering of a Mine Surface Facility (Figure 3.13). Holes drilled for bulk sampling and Seismic Cone Penetration testing ranged from 30 - 80 m depth. A single hydrological hole was drilled to 500 m depth. The project has an estimated resource of 98 Mt (Inferred) and is expected to produce 2 - 4 Mt of washed coal annually for 30 - 40 years from the Trojan and Superior seams of the Gething Formation by means of underground (room-and-pillar or longwall) mining and coal processing. The Trojan seam is historically reported at 2.1 - 2.6 m thickness in the Dowling Creek area. Structurally, the





**Figure 3.13.** Gething Creek – *Amblydactylus gethingi* fossil trackway located about 3 km southwest of the Gething property.

area consists of a north-northwest trending, gently-dipping broad syncline, flanked by sharply faulted anticlines on the east and west. The project is in the Pre-Application stage of the EA process.

## 3.4 EXPLORATION HIGHLIGHTS

### 3.4.1 Coal Projects

#### 3.4.1.1 South of Tumbler Ridge

In September, Colonial Coal International Corp provided an updated resource estimate of 189.4 Mt (Measured and Indicated), and 194.7 Mt (Inferred) for the **Huguenot** prospect, 82 km southeast of Tumbler Ridge. The estimate includes 2011 drilling results for the North Block, delineates and updates historical results for the Middle and South Blocks, and incorporates underground resources of 97.2 Mt (Measured and Indicated), and 156.5 Mt (Inferred). The 2012 exploration program included resource drilling, large-diameter drilling for coal quality, and rotary pilot holes. Drilling was helicopter-supported as there is no ground access above 1400 m elevation due

to classification as a wildlife high alpine sensitivity area. Environmental baseline studies and data collections are ongoing. Coal measures are in the Gates Formation on the northeast limb of the Belcourt anticlinorium, where 4 of 9 total seams represent 78% of the resource. Cumulative seam thickness in the North Block averages 24.1 m. The area is the historic Holtslander South area of the Belcourt Coal Joint Venture.

Canadian Dehua International Mines Group Inc (Dehua) commenced an exploration program at **Wapiti River** (40 km southeast of Tumbler Ridge) consisting of 55 drill holes ranging from 500 - 1300 m in depth, to understand subsurface and coal characteristics. The company envisions an underground longwall and room-and-pillar operation producing 8 Mt of washed coal annually, and estimates an HCC resource of 7000 Mt at the prospect. Drilling was planned to continue to 2013, then a Feasibility Study initiated. Environmental baseline studies began in May. The property is centered on the Duke Mountain Block of the Monkman developed prospect. Twelve Gates Formation coal seams have historically been reported at Monkman, with the upper 3 seams generally less than 1 m thick, and the lower 9 seams (B1 to B9) ranging from 1.6 to 5.2 m. The property consists of a major northwest trending anticlinorium bounded and cut by a series of northwest and southwest dipping thrust faults. The historic Wapiti Block sits on the moderately-dipping northeast limb of the anticlinorium.

Colonial Coal International Corp awaits granting of coal licenses and appropriate work permits to proceed with exploration on the **Flatbed** property located 20 km south of Tumbler Ridge. A potential underground operation would mine flat-lying coal seams of the Gates formation at 400 m depth, increasing to an estimated 1200 m at the southern end of the property.

#### 3.4.1.2 Wolverine Valley area

Exploration continued at the **Bullmoose River** project of Dehua and Canadian Bullmoose Mines Co Ltd, 26 km west of Tumbler Ridge. Drilling programs for 2011/12 included up to 139 holes ranging in depth from 500 m to 1300 m, with similar objectives as above described for the Wapiti River project. An underground longwall and room-and-pillar mine is proposed, with annual production of 2 - 3 Mt washed coal and a mine life of 30 - 40 years. Drilling will continue into 2013 and a Feasibility Study will be initiated. The regional Bullmoose thrust fault lies 5 km southwest of the project, and the Mt. Spieker and Sukunka (Bullmoose) trend, 9 km west of the project, consists of a broad syncline cut by southwest dipping thrust faults. Surface geology in the project area includes the Hulcross, Boulder Creek, and Hasler formation rocks which sit stratigraphically above buried Gates formation. Coal seams are historically reported in both the Gates (4 or 5 seams ranging from 0.5 to 4 m thick) and Upper Gething formations (up to 3



seams including the Bird seam, which is 0.5-3.5 m thick). Environmental baseline studies are underway.

### ***3.4.1.3 Chetwynd-Pine River Area***

Xstrata Coal further established their role in the Peace River Coalfield after the 2011 acquisition of First Coal Corp's tenures and Cline Mining Corp's **Lossan** deposit, a 185 Mt resource (Measured and Indicated) 49 km southwest of Chetwynd. In March, Xstrata acquired the **Sukunka** deposit from Talisman Energy, a 236 Mt resource (Measured and Indicated) 56 km south of Chetwynd. Additionally, it was announced that JX Nippon Oil and Energy of Japan would acquire a 25% stake in Xstrata's western Canadian operations to form a joint venture wherein Xstrata will operate and manage the assets while JX Nippon acts as the exclusive marketing agent in Japan. During a trade mission to Asia in May, the BC Premier announced the joint venture's investment of \$35 million to conduct a Prefeasibility Study of the newly named **Suska** (formerly Lossan) coal project, to be completed in the first half of 2013. A 70-hole drilling program (Phase-1) was conducted at **Suska** to confirm historical data, collect geological and coal quality information, upgrade the resource, and test a grassroots area south of the Brazion River. Twelve groundwater monitoring wells were also drilled for baseline studies. Drilling confirmed the reported seams (No. 1, 2, 3, 4, and 5 with increasing depth) trending northwest along Axis Creek where five conceptual pits have been historically developed. Seam thickness is variable, with the No. 1 split seam 8 - 15 m thick at the south part of the trend, and No. 3 and 5 seams expected to thicken to the north. The Gething Formation seams occur within the Lossan-Axis synclinal fold pair. In the south, chevron folds and thrust faults are predominant; in the north the major structure is a synclinorium. Phase-2 drilling as proposed will consist of 150 holes and run from January to March 2013. Coal product is expected to be 60% HCC and 40% PCI. Baseline studies started in Dec 2011.

A similar 64-hole drilling program with eight monitoring wells was permitted for **Sukunka** (Sukunka Bullmoose) in November with work to begin in 2013. The program is designed to confirm historic drilling and fill gaps in the data. A combined surface and underground longwall operation is envisioned beginning with surface mining at the north part of the property, followed by underground mining to the southeast below Bullmoose Mountain. Mining will target the upper and lower Chamberlain seam of the Gething Formation, historically reported as a continuous seam with a total thickness of 1.4 - 8.3 m. The property consists of a series of northwest-trending gentle folds within a broad synclinorium, and northwest-trending, southwest-dipping thrust faults with greater concentration to the north. Xstrata has no current plans to develop the 41 Mt resource (Measured and Indicated) acquired from First Coal Corp

at **Goodrich Central South**, located 52 km southwest of Chetwynd.

WEWC continued exploration programs at the Brazion Group expansion projects in the Falling Creek and Willow Creek areas. At **Mink Creek East** and **Mink Creek West**, 36 km southwest of Chetwynd, 37 holes were drilled for preliminary coal quality information and coal seam characteristics. At **Hudette**, located 15 km south of Willow Creek, 38 holes were drilled to determine structure and characteristics of the Brenda upper and lower seam. At **Willow South**, 18 holes were drilled to determine fault structure and seam characteristics; 17 holes were drilled for coal quality sampling of seams No. 5-7. At **Willow West**, 15 holes were drilled to confirm fold structure and the presence of upper seams.

### ***3.4.1.4 Hudson's Hope area***

Jameson Resources Ltd acquired Dunlevy Energy Inc at the end of 2011, along with the **Dunlevy** project, located 44 km northwest of Hudson's Hope. The company also acquired certain assets of Nexx Coal Inc including the **Graham River**, **Peace Reach**, and **Carbon East** projects in the Peace Reach area. Prospecting and hand trenching along existing road cuts at **Dunlevy** exposed Gething Formation coal seams of about 2 m thickness. An exploration program consisting of drilling, geophysics, and coal quality test work is awaiting permit. Mapping and prospecting was carried out on each of the four projects.

From June to September, Anglo/PRC and contractor Plateau Minerals Ltd conducted a mapping and prospecting program at **Williston North** (Pink Mountain), the northernmost prospect of the Peace River Coalfield, 160 km northwest of Fort St. John. Gething Formation coal seams, 1-2 m thick, were identified in the southeastern part of the property, warranting further work. Historically, 19 coal seams have been reported in the area, with 4 main seams averaging about 7 m cumulative thickness.

## **3.4.2 Industrial Mineral Projects**

### ***3.4.2.1 South of Tumbler Ridge***

Homegold Resources Ltd conducted a mapping, hand-trenching, geochemical sampling, and small drilling program at the **Wapiti** phosphate project, located 76 km south of Tumbler Ridge. Four holes were drilled using a hand-portable Gopher drill. Stratiform pelletal phosphate and phosphatic pebble conglomerates occur within the Whistler Member of the Triassic Sulphur Mountain Formation, Spray River Group. Structurally the area is similar to the coal belt with northwest trending tight

anticlines and relatively broad synclines. The main ore mineral in upwelling phosphate deposits is microcrystalline francolite, a carbonate-rich variety of fluoroapatite. Phosphorus has agricultural and industrial chemical applications.

### 3.4.2.2 Liard Basin Area – Ancestral North America

In September, Camisha Resources Corp entered into an agreement to acquire Prima Fluorspar Corp and the **Liard Fluorspar** property, located 212 km west-northwest of Fort Nelson, with the resulting company to be renamed Prima Fluorspar Corp. The property has a historical resource estimate (non NI-43-101 compliant) of 3.2 Mt averaging 32% fluorite based on 61 drill holes. The company plans to confirm and expand the historical resource with 80 - 100 shallow drill holes in 2013, and a PEA for an open pit operable resource is anticipated for fourth quarter 2013. Historical metallurgical testing indicates acid-grade fluorspar (selling at \$550-\$600 per tonne as of September 2012) could be produced using conventional flotation methods. Fluorspar is used in the production of hydrofluoric acid, fluorocarbons (aerosols, refrigerant), fluoropolymers (Teflon, Gor-Tex), aluminum, steel, petroleum, enriched uranium, concrete, and medicines.

A series fluorspar prospects and showings occur in an 18 km long belt trending northward from Liard Hot Springs Provincial Park. The belt is concentrated in a 2-4 km wide zone in the core of a gently south-plunging open anticline. The deposits occur as irregular lenticular replacement bodies or cementing angular-clast breccias along the unconformable contact between Middle Devonian Dunedin Formation limestone and Upper Devonian Besa River Formation argillite. Mineralization typically consists of dark purple to black fluorite and witherite ( $\text{BaCO}_3$ ) to about 60%, with the remainder barite, quartz and calcite. A  $332 \pm 56$  Ma fission-track age of fluorite from the Gem showings (White, 1988) overlaps the Devonian-Mississippian age of most other carbonatite-syenite systems in the province (Pell, 1994, p. 27), suggesting the Liard fluorspar deposit is part of the Rocky Mountain Carbonatite Belt. A carbonate-related origin for the Rock Canyon Creek fluorite-REE showing in the East Kootenay region has also been suggested (Graf, 1985; Hora and Kwong, 1986; Pell, 1987).

## 3.5 OUTLOOK FOR 2013

Several mine development and advanced projects are expected to reach significant benchmarks in 2013 including potential mine development at **EB**; a decision on the Feasibility Study and the Mines Act Permit Amendment at **Quintette**; completion of a Feasibility Studies and Mines Act Permit Applications for **Carbon**

**Creek and Roman Mountain**; ongoing Surface Facility Area development and excavation of bulk sample at **Murray River**; completion of Prefeasibility Study at **Suska**; Feasibility Studies to be initiated at **Wapiti River** and **Bullmoose River**; and a PEA to be completed at **Liard Fluorspar**. Other major coal projects including **Huguenot**, **Belcourt**, **Sukunka**, and **Gething** are expected to advance to Feasibility.

## ACKNOWLEDGMENTS

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# EXPLORATION AND MINING IN THE THOMPSON-OKANAGAN-CARIBOO REGION, BRITISH COLUMBIA

Regional Office, Kamloops

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## EDITOR'S NOTE

No comprehensive summary for the Thompson-Okanagan-Cariboo region was available at press time. The region has a healthy exploration, development and mining industry. This editor's contribution is intended to highlight mines and exploration projects that represent the region. Regrettably, many worthy projects have been omitted.

The region contains roughly 36 industrial mineral mines, 56 rock quarries, 480 sand and gravel pits, and 704 placer mines that all contribute to local economies but are not reviewed here.

## 4.2 MINES

Table 4.1 lists operating metal and industrial mineral mines discussed in this report. Figure 4.1 shows their locations.

### 4.2.1 Metal Mines

With five major operating mines the Thompson-Okanagan-Cariboo region hosts roughly half of the province's metal mines. Two mine openings in 2012 and large expansions in the last few years have bolstered the local economy in a time when other industries have contracted.

Construction was completed this year at the **New Afton** gold-copper mine of New Gold Inc and it opened officially ahead of schedule in June. Metal production is forecast to be between 13.6-15.9 thousand tonnes Cu and 1 100-1 400 kilograms Au. The development cost of the mine is approximately \$765 million and is expected to achieve a mill rate of 11 000 t/d in early 2013. This operation ushers in a new era of large tonnage underground mining, utilizing block cave techniques that are anticipated to be closely studied by other British Columbia projects with higher grade resources at depth. In September the company celebrated their achievement with an Open Day attended by over 1 800 people from the Kamloops area as well as government officials (Figure 4.2).

The **Copper Mountain** copper mine near Princeton has been in production since August 2011 and is operated

by a partnership of Copper Mountain Mining Corporation (75%) and Mitsubishi Materials Corporation (25%). An increased mining rate has occurred to optimize mill throughput closer to 35 000 t/d and enhance copper recovery. A multi-year exploration program is actively upgrading resources, testing ore depths and mineralization outside the current mine plan.

Near Williams Lake, the **Gibraltar** copper-molybdenum mine, operated by Taseko Mines Limited and Cariboo Copper Corp, is nearing the conclusion of the third phase of the Gibraltar Development Plan to modernize the mine. By the end of 2012 the company will have invested ~\$700 million. Once completed the mine is expected to be Canada's second largest copper producer.

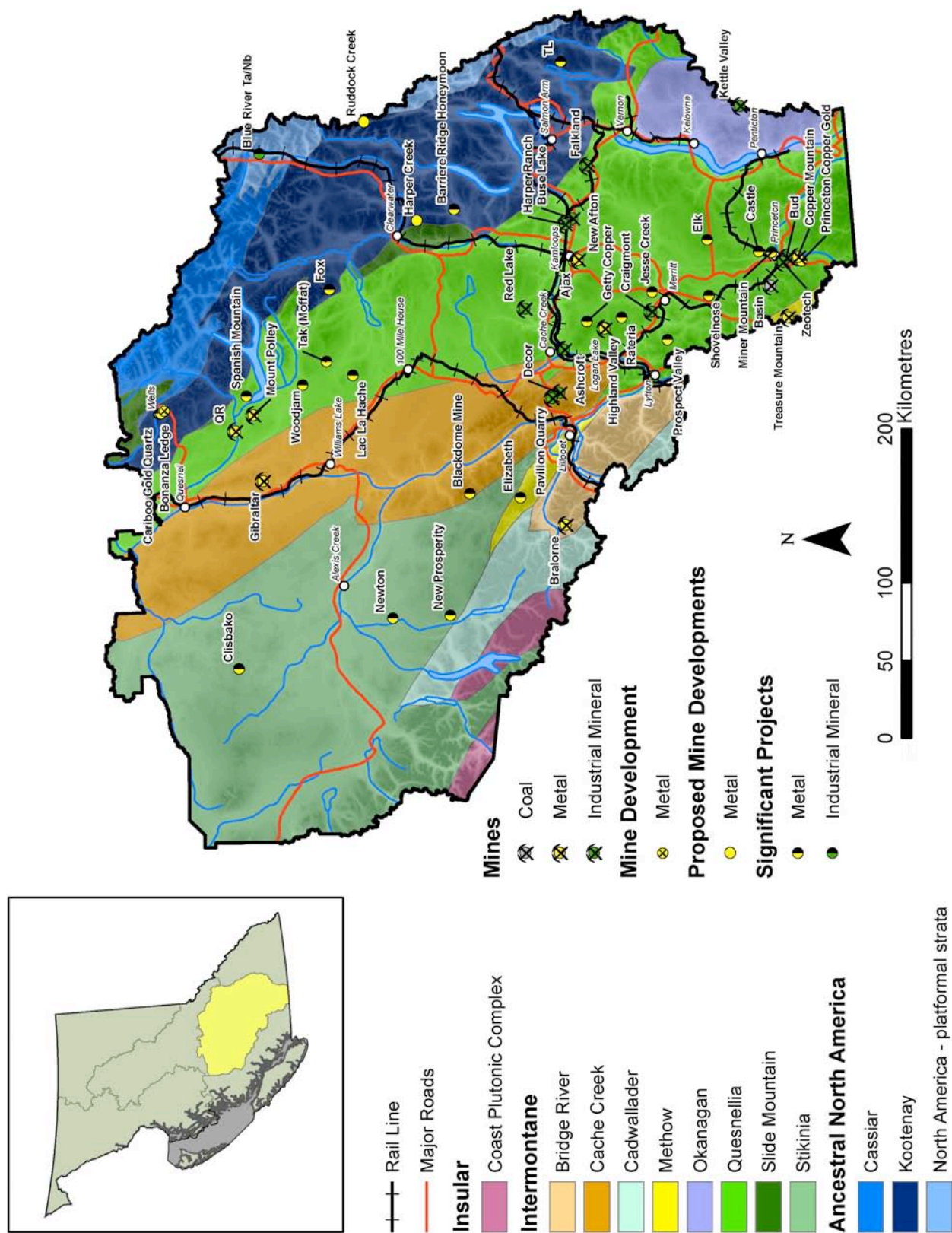
The **Highland Valley Copper** copper-molybdenum mine near Logan Lake is operated by Teck Highland Valley Copper Partnership (97.5% Teck and 2.5% Highmont Mining Company Ltd) and the largest base metal mine in Canada. Construction is underway on a \$475 million mill optimization that is part of an extended mine life to 2026.

Located West of Williams Lake, the **Mount Polley** copper mine of Imperial Metals Corporation continues to search for resources outside its main producing Springer pit. Exploration efforts include drilling at the Springer and Cariboo pits, Quarry, WX and C2 zones plus underground drilling from a decline into the Boundary zone.

The **QR** mine of Barkerville Gold Mines Ltd has operated sporadically in recent years and was shut in November 2011 due to depletion of sustaining quantities of ore. In early December, mining resumed in the West zone with the intention to produce gold late in the year. The mill awaits shipments of new ore from the Bonanza Ledge mine, near Wells, which is under development.

In May, Huldra Silver Inc began a small scale, high grading, test operation at its **Treasure Mountain** project located south of Merritt, in upper Tulameen River. The Treasure Mountain deposit is described as a stacked series of high grade silver-lead-zinc veins in Cretaceous sedimentary rocks of the Pasayten Group. Vein material is mined underground and transported to Merritt for concentrating. The mill is located at the former Craigmont tailings facility where a magnetite recovery plant has operated for many years. A resource estimate (indicated, but not in conformity with NI 43-101) prepared in 2009 was 33 000 tonnes grading 828 g/t Ag, 4.16% Pb, and 3.8% Zn, at a 311 g/t Ag cut-off.





**TABLE 4.1 THOMPSON-OKANAGAN-CARIBOO REGION MINE PRODUCTION, 2012**

<b>Mine</b>	<b>Operator</b>	<b>Deposit Type / Commodity</b>	<b>Production</b> (tonnes or kilograms; 2012 estimate by government)	<b>Number of Employees</b> (date)	<b>Proven and Probable Reserves</b> (tonnes; date published)
<b>Metals</b>					
Bralorne	Bralorne Gold Mines Ltd	Vein Au	200 kg Au	47 (October 2011)	Not available
Copper Mountain	Copper Mountain / Mitsubishi Materials	Alkalic porphyry Cu, Au, Ag	26 000 t Cu; 540 kg Au, 11 900 kg Ag	360 (Dec 2012)	211 000 000 t at 0.36% Cu, 0.1 g/t Au and 1.38 g/t Ag (28 July 2009)
Gibraltar	Taseko Mines Limited / Cariboo Copper Corp	Calc-alkalic porphyry Cu, Mo	40 300 t Cu, 660 t Mo	630 (Dec 2012)	802 000 000 t at 0.30% Cu and 0.008% Mo (31 March 2011)
Highland Valley Copper	Teck Highland Valley Copper Partnership	Calc-alkalic porphyry Cu, Mo	105 000 t Cu; 4 500 t Mo	1267 (Nov 2011)	673 300 000 t at 0.29% Cu and 0.008% Mo (31 Dec 2011)
Mount Polley	Imperial Metals Corporation	Alkalic porphyry, Skarn Cu, Au, Ag	15 400 t Cu, 1 460 kg Au, 2 800 kg Ag	370 (Nov 2011)	87 300 000 t at 0.29% Cu, 0.3 g/t Au and 0.41 g/t Ag (1 Mar 2012)
New Afton (June 2012 start up)	New Gold Inc	Alkalic porphyry Au, Cu	13 600-15 875 t Cu 1 100 -1 400 kg Au (2012 guidance)	498 (Dec 2012)	47 900 t at 0.64 g/t Au, 2.0 g/t Ag and 0.90% Cu (31 Dec 2011)
QR (Dec 2012 start up)	Barkerville Gold Mines Ltd	Skarn Au	Unreported	~70	Not available
Treasure Mountain (May 2012 start up)	Huldra Silver Inc	Vein Ag, Pb, Zn	Unreported	~50	Not available
<b>Coal</b>					
Basin	Coalmont Energy Corp	Thermal coal	0 (mining to resume in 2013)	Not available	Not available
<b>Industrial Minerals</b>					
Ashcroft	IG Machine and Fiber Ltd (IKO Industries Ltd)	Basalt (roofing granules)	350 000 t	55 (plant & quarry)	
Bud	Absorbent Products Ltd	Bentonite		see Red Lake	
Buse Lake	Lafarge Canada Inc	Volcanic ash (alumina-silica)		see Harper Ranch	
Craigmont	Craigmont Mines Joint Venture	Magnetite tailings	60-70 000 t	~30 (plant; seasonal)	
Decor	Pacific Bentonite Ltd	Alumina, landscape rock		~2 (including trucking)	
Falkland	Lafarge Canada Inc	Gypsum	6 000 t	see Harper Ranch	
Harper Ranch	Lafarge Canada Inc	Limestone	220 000 t	34 plus 10 contractors (plant & 3 quarries)	
Kettle Valley quarries	Kettle Valley Stone Company	Ashlar, flagstone, thin veneer		~40 (plant & quarries)	
Klinker	Okanagan Opal	Opal			
Pavilion	Graymont Western Canada Inc	Limestone	190 000 t	~34 (plant & quarry)	
Red Lake	Absorbent Products Ltd	Diatomaceous earth		40 (plant & 3 quarries)	
Zeotech Bromley Creek	Heemskirk Canada Ltd.	Zeolite			



Figure 4.2. New Afton opens with a blast! Pyrotechnical demonstration from the mine's Open Day in September (Steve Rothman photo).

Bralorne Gold Mines Ltd has been milling approximately 80 t/d from stockpiled and underground resources at its **Bralorne** gold mine. The company is mining gold-bearing mesothermal quartz veins in relatively undeveloped areas between three former mines: Bralorne, King and Pioneer. The company is currently evaluating its existing resources to identify targets for future development and advance an objective of expanding the operation from under 100 t/d to over 200 t/d. The company has been actively developing the BK-3 zone through drifting and underground drilling.

## 4.3 MINE DEVELOPMENT AND EVALUATION

### 4.3.1 Mine Development

In December 2011, the **Bonanza Ledge** project of Barkerville Gold Mines Ltd received approval under the *Mines Act* to develop an open pit gold mine near Wells. The open pit site has been logged and grubbed in preparation for mining and an agreement has been reached with forestry operators to utilize the 500 Forest Service Road to truck the ore 100 km to the QR Mine where it will be milled. The permit at the QR mine has

been amended to accommodate the ore and the mill has been made ready. The company reports that the current mine plan is to extract approximately 73 000 tonnes of gold ore per year (grading 9.05 g/t Au) over a period of four years. Ore consists of native gold in quartz veins within carbonaceous and chloritic phyllite. Stated reserves (as of August 2009) include 130 724 tonnes grading 10.227 g/t Au in the proven category and 166 808 tonnes grading 8.114 g/t Au in the probable category.

Coalmont Energy Corp, a subsidiary of Arthon Industries Limited, continues to move toward resuming production at the **Basin** mine near Coalmont which contains thermal-grade coal (Figure 4.3). The mine had been on care and maintenance since 2007. Activities this year included the acquisition of a new wash plant, road upgrades, and securing transport to tidewater.

### 4.3.2 Mine Evaluation

The proposed **New Prosperity** gold-copper mine of Taseko Mines Limited received an environmental certificate from the BC Environmental Assessment Office in January 2010. A revised proposal has been submitted to the Canadian Environmental Assessment Agency (CEAA) after an initial design was rejected. In September the company formally submitted an Environmental Impact Statement to an appointed review panel for consideration. The redesigned project has moved mine infrastructure in an effort to protect a water body of local significance. The deposit is located 125 km southwest of Williams Lake. It is described as a gold-copper porphyry with proven and probable reserves of 830 million tonnes grading 0.42 g/t Au and 0.23 % Cu.

Yellowhead Mining Inc is advancing its **Harper Creek** copper-gold-silver deposit near Vavenby, about 90 km northeast of Kamloops. It is a stratiform deposit within metamorphosed volcanic and volcano-sedimentary rocks of the Eagle Bay Formation. The company is working towards submission of an environmental assessment of the project as part of the formal project assessment process. On the ground, a comprehensive baseline study is underway and ongoing consultation with local communities and First Nations is occurring. A feasibility study is now complete and contemplates a 70 000 t/d mine exploiting reserves of 704.4 million tonnes at 0.26% Cu, 0.029 g/t Au and 1.14 g/t Ag (proven and probable). Continued exploration activities are aimed at upgrading further resources and include an 11 000 m drill program that started in early winter 2012.

The **Ruddock Creek** zinc-lead deposit is in the pre-application stage of the BC Environmental Assessment process. The project is owned by Imperial Metals Corporation (65%) and joint venture partners Mitsui Mining and Smelting Co Ltd and Itochu Corporation (35%). The deposit is described as sedimentary





Figure 4.3. Basin coal mine is expected to resume production early in 2013 (image courtesy of Coalmont Energy Corp).

exhalative, Monashee or Broken Hill-type, within marble, gneiss and calc-silicate rocks. A mineral resource estimate, released in March 2012, reported 4.65 million tonnes of 6.77% Zn and 1.38% Pb (indicated) and 5.38 million tonnes of 6.69% Zn and 1.31% Pb (inferred), using a 4.0% combined Pb and Zn cut-off.

A Preliminary Economic Analysis, which will include a mineral resource estimate that incorporates 2012 drilling results, is anticipated early in 2013. On-site activities included surface drilling at the V and Creek zones, and underground drilling and a bulk sample extraction from the E zone.

On the southern outskirts of Kamloops lies the **Ajax** copper-gold porphyry deposit which is undergoing environmental assessment as a proposed mine by KGHM Ajax Mining Inc. Its proximity to the city has demanded the company's vigilance in undertaking extensive baseline studies on air and water quality, dust and vibration, as well as traffic and socioeconomic impacts. The proposal would see a 60 000 t/d open pit mine based on reserves of

503 million tonnes of 0.27% Cu and 0.17 g/t Au. The site is a former open pit operation which was part of the Afton mine that closed in the mid-1990s.

In December, Spanish Mountain Gold Ltd released a Preliminary Economic Assessment of its flagship **Spanish Mountain** project, a low-grade, large tonnage gold and silver deposit within fine grained sedimentary rocks. Located 66 km northeast of Williams Lake, this project represents a relatively new class of deposits known provincially as shale-hosted vein deposits – although the gold values are largely disseminated outside of veins. The company has utilized a resource of 216.2 million tonnes of 0.46 g/t Au and 0.68 g/t Ag (measured and indicated) and 316.7 million tonnes of 0.36 g/t Au and 0.65 g/t Ag (inferred) in its recent assessment. This supports a 40 000 t/d operation for up to 15 years at a capital cost of \$755.9 million. The operation would see 2.8 million ounces of gold and 1 million ounces of silver over the life of mine at a cash cost of \$774/oz. The project has been introduced to the formal environmental assessment process where it is at a pre-application stage.

## 4.4 EXPLORATION PROJECTS

Projects are arranged by deposit type and geography. Table 4.2 lists exploration projects discussed in this report. Figure 4.1 shows their locations.

### 4.4.1 Porphyry projects

#### *Thompson River - Shuswap Lake*

At **Highland Valley Copper** mine, Teck Highland Valley Copper Partnership conducted an IP survey around the former Bethlehem mine and drilled near their Valley pit. Results have not been published.

Getty Copper Inc. continues to seek partners for its **Getty North** deposit, **Getty South** deposit, and **Getty West** zone. No exploration was conducted in 2012.

At the **Rateria** porphyry copper-molybdenum property, located 12 km southeast of Highland Valley Copper mine, Happy Creek Minerals Ltd. collected a bulk sample from Zone 1 drill core for metallurgical testing and drilled two holes on Zone 2, which has anomalous rhenium. Four km west of Rateria, the company flew a geophysical survey at their **West Valley** property.

In September, Blue River Resources Ltd started a 1 500 m drilling program on their **Highland Valley North Project**, a copper porphyry target located 6 km east of Highland Valley Copper mine. Results are pending. The company also planned work on their **Castle** property, another porphyry target located 25 km north of Princeton.

Dakar Resources Corp drilled four holes on the **Nap** property, a porphyry-related copper-gold-silver-zinc target, located 40 km south of Kamloops (Figure 4.4). A company news release (dated 2012-11-29) states: “copper mineralization occurs mainly as disseminations of chalcopyrite in biotite hornfelsed metasediments with lesser augite porphyry.”

In January, Dundarave Resources Inc optioned the **Jesse Creek** property from owners John Dawson and Gary Belik. The property is 5 km northeast of Merritt. In the spring, the company flew a 1 050 line km helicopter-borne magnetic gradiometer survey, followed by 69 line km of IP in the fall. The company reports that these surveys (along with mapping, sampling and known mineralization), confirm that the property has two porphyry systems: calc-alkaline and alkaline. The calc-alkaline system occurs in the north, and may be a faulted extension of the Guichon batholith. The alkaline system occurs in the south and has six known mineral occurrences (of skarn and intrusive affinities) associated with it. Dundarave sub-optioned the claims to Ocean Park Ventures Corp who started a 2 000 m drilling program in November. Results are pending.

#### *Cariboo*

In the Takomkane batholith, the **Woodjam North** and **Woodjam South** properties located 50 km NE of Williams Lake continued to be explored by Gold Fields Horsefly Exploration Corp. In March the company released a preliminary resource estimate for the Southeast Zone, comprising 145.5 million tonnes at 0.33% Cu and 0.06 g/t Au. In August, the company reported discovering a new zone, named the Three Firs, where three of seven drill holes had disseminated copper and gold over drill lengths of from 100 to 350 metres. By year's end over 36 600m of drilling had been completed on several of Woodjam's targets.

Fjordland Exploration Inc regained 100% interest on its **Tak** property after Capstone Mining Corp decided not to proceed with its option. Future exploration will focus on refining IP targets, followed by drilling, subject to financing.

In December, Constantia Resources Ltd received approval to drill the **Maggie** prospect, located 15 km north of Cache Creek. The company plans 75 000 m of drilling, in 200 holes, over 5 years. According to MINFILE, exploration in the 1960s identified a resource of 181.4 million tonnes grading 0.28% Cu and 0.029% Mo.

#### *Chilcotin*

Continued drilling by Amarc Resources Ltd on the **Newton** property, a disseminated gold and silver target southwest of Williams Lake, has led to the release of a resource estimate of 111.5 Mt of 0.44 g/t Au and 2.1 g/t Ag using a 0.25 g/t Au cut-off (inferred). Geologically, the project carries many hallmark similarities to other large epithermal-style projects being explored in the province, including the exciting Blackwater project located approximately 175 km to northwest. Evidence of metallogenic similarities among several projects in this part of the province is leading to the term “Chilcotin Plateau Gold Belt” as a descriptor to bind them.

The company reports this epithermal system formed approximately 72 million years ago, contemporaneously with felsic volcanic and intrusive rocks that were emplaced into a structurally-active graben environment. Mineralization accompanies extensive zones of strong quartz-sericite alteration.

In March, Highpointe Exploration Inc released results from a fall 2011 reconnaissance drill program on the **Tasco** property, 150 km southwest of Williams Lake. Two holes were drilled, totaling 683 m. Hole 1 intercepted 216 m of 0.29% Cu, 0.02% Mo and 1.9 g/t Ag.

**TABLE 4.2. SELECTED EXPLORATION PROJECTS, THOMPSON-OKANAGAN-CARIBOO REGION, 2012**

<b>Property</b>	<b>Operator</b>	<b>MINFILE</b>	<b>Commodity</b>	<b>Deposit Type</b>	<b>Work Program</b>
Afton Area (West Ajax, East Ajax)	Abacus Mining and Exploration Corp / KGHM	092INE 012, 013, 028, 030	Cu, Au, Ag, Pd	Porphyry	FS, ES, DD
Blackdome Mine	Sona Resource Corp	092O 053, 051, 052	Au, Ag	Vein / Breccia	A
Blue River Tantalum/Niobium (Upper Fir)	Commerce Resources Corp	083D 005, 035	Ta, Nb	Magmatic	MS, G,
Bonanza Ledge	Barkerville Gold Mines Ltd	093H 019	Au	Vein / Breccia	Preparations for mining
Bralorne Camp	Bralorne Gold Mines Ltd	092JNE 164, 001	Au, Ag	Vein / Breccia	DD
Cariboo Gold Quartz	Barkerville Gold Mines Ltd	093H 019	Au	Vein / Breccia	DD; resource estimate
Copper Mountain (Exploration)	Copper Mountain Mining Corporation	092HSE 001, 024	Cu, Au	Porphyry	DD
Elizabeth	Sona Resources Corp	092O 012	Au, Ag, Cu, Mo	Vein / Breccia	A
Elk (Siwash North)	Gold Mountain Mining Corporation	092HNE 096	Au, Ag	Vein / Breccia	IP, DD; BU
Fox / Ridley Creek	Happy Creek Minerals Ltd	093A 259	W, Mo, Ag	Skarn	DD
Golden Loon (Gold)	Planet Mining Exploration Inc	092P 141	Au, Ag	Vein / Breccia	DD, MS
Golden Loon (Platinum)	Planet Mining Exploration Inc	092P 043	Ni, Co, Pt, Pd	Magmatic	GC
Harper Creek	Yellowhead Mining Inc	082M 008, 009	Cu, Ag, Au, Zn, Mo	Stratiform Sulphide	PFS, EN, DD
Highland Valley Mine (Exploration)	Teck Highland Valley Copper Partnership	092ISE 013	Cu, Mo	Porphyry	DD; IP
Jesse Creek	Dundarave Resources Inc / Ocean Park Ventures Corp	092ISE 064	Cu, Au	Porphyry	AB-MG, IP, DD
Lac La Hache (Aurizon; Peach L, Spout L)	GWR Resources Inc	092P 001, 002, 034, 035	Cu, Au, Fe, Ag	Skarn / Porphyry	DD, GP
Miner Mountain	Sego Resources Inc	092HSE 078, 203	Cu, Au, Ag	Porphyry	DD
Newton	Amarc Resources Ltd	092O 050	Au, Ag	Vein / Breccia	DD
Ruddock Creek	Imperial Metals	082M 082	Zn, Pb, Ag	Massive sulphide	DD; PEA
Shovelnose	Strongbow Exploration Inc / Westhaven Ventures Inc	092HNE 309	Au	Vein / Breccia	DD
Woodjam	Gold Fields Horsefly Exploration Corporation	093A 019	Cu; Au	Porphyry	DD

**Work Program Abbreviations:**

A = access; trail, road construction on claims; AB-EM = airborne electromagnetics; AB-MG = airborne magnetics; AB-RD = airborne radiometrics; BU (X tonnes) = bulk sample (weight in tonnes); CD = condemnation drilling; CQ = coal quality testing; CT = carbonization test (coal); DD (X m) = X metres of diamond drilling; EN = environmental baseline studies/monitoring, remediation work; FS = feasibility studies; G = geology, mapping, etc; GC = geochemical sampling (rock, soil, silt, etc); GD = geotechnical drilling; GP = geophysics (general); IP = Induced Polarization; 3D-IP; MG = magnetics; MK = marketing (primarily for industrial mineral products); MS = metallurgical studies; OB = overburden drilling; OP-BU = open-pit bulk sample; P = prospecting; PD = percussion drilling; PF = pre-feasibility studies; PP = pilot plant; R = reclamation; RC = reverse circulation drilling; TR = trenching; UG (X m) = X metres of underground development; UG-BU = underground bulk sample; UT = UTEM; VLF; WT = washability test (coal)





Figure 4.4. Drilling at the Nap property south of Kamloops (Leo Lindinger photo).

### ***Similkameen River***

Approximately 4 km south of the Copper Mountain mine, Anglo-Canadian Mining Corp drilled three holes (719 m) at its **Princeton Copper Gold** project. Results released in August note that hole PR-12-26, at the Combination Zone, intersected 20 metres grading 0.64% copper and 2.6 g/t Ag. The company has permits for a further 15 000 m of drilling.

In January, Sego Resources Inc conducted a diamond drilling program (8 holes; 1 622 m) on the Cuba Zone at their **Miner Mountain Copper-Gold** Porphyry Project. The program confirmed results of previous percussion drilling.

### **4.4.2 Skarn Projects**

#### ***Cariboo***

GWR Resources Inc made progress on several fronts within its **Lac La Hache** Project. The project embraces a large area (400 sq km) and a multiplicity of deposit types and exploration targets which make classification and

discussion challenging. Broadly speaking, mineralization ranges from high grade, massive to semi-massive, skarns, veins, replacements and breccias to low grade porphyries and epithermal disseminations.

In January the company reported the acquisition of the **Murphy** Block, 33 claims covering 31 140 ha that lie north of (and are contiguous with) their existing property.

In June the company reported its first ever NI 43-101 compliant resource estimate for the **Spout** copper-magnetite-gold-silver skarn zones: a 23.4 million tonne, open-pit mineable resource (indicated and inferred categories) containing 54 million kg Cu, 1 013 kg Au, 24 500 kg Ag and 2.2 million tonnes magnetite (with a cut-off of 0.2% Cu equivalent).

The company drilled 3 895 m (13 holes) including reconnaissance drilling along the projected contact of the Murphy intrusion and shallow drilling at the **Aurizon South** gold-copper-silver zone, which succeeded in extending the zone 200 m farther to the south.

The company also conducted grassroots exploration on the Murphy Block. The survey defined a 32-km long, arcuate aeromagnetic anomaly that appears to align with zones of known mineralization, suggesting that the entire feature is prospective (Figure 4.5).



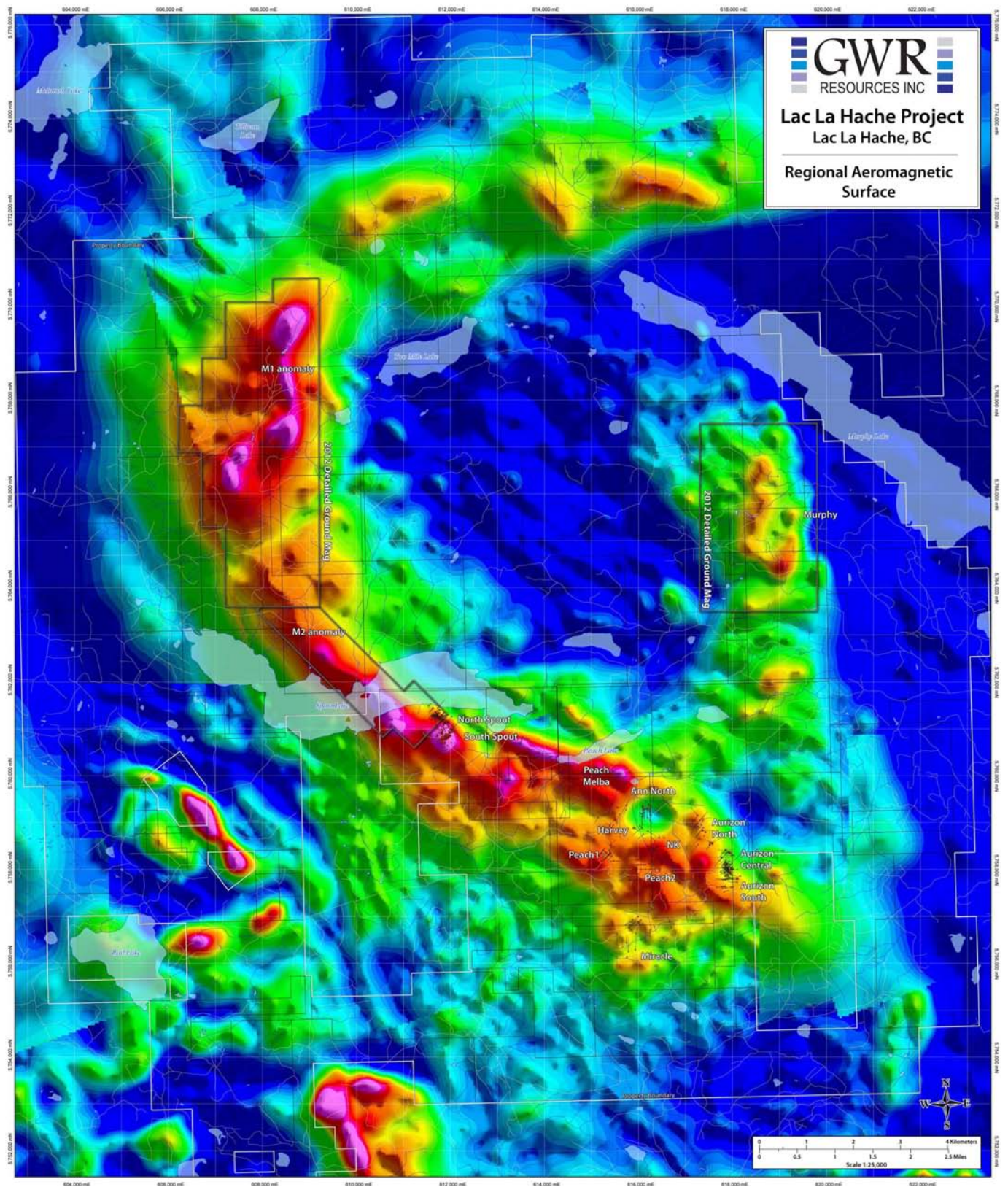


Figure 4.5. Arc-shaped aeromagnetic anomaly at Lac la Hache project (image courtesy of GWR Resources Inc).

At the **Fox tungsten-molybdenum** property, 75 km northeast of 100 Mile House, Happy Creek Minerals Ltd reported encouraging results from follow-up drilling of the Ridley Creek zone as well as step-out drilling on the BN and BK zones located, respectively, 1 km to the south and north of Ridley Creek prospect. At the BN zone, the company reported a drill intersection of 14.8 m of 4.0% WO<sub>3</sub>. At the BK, drilling intersected 5.0 m of 0.68% WO<sub>3</sub>. More work is planned for 2013.

#### 4.4.3 Vein and breccia projects

##### *Thompson River - Shuswap Lake*

WestKam Gold Corp reached an Advanced Exploration Agreement with the Stk'emlupsemc to Secwepemc Nation in preparation for work on their **Bonaparte** property, a series of en echelon quartz veins within the Thuya batholith, located 35 km north of Kamloops. Exploration is anticipated to begin in 2013.

Planet Mining Exploration Ltd continued to work on their **Golden Loon** property, located 8 km west of Little Fort. The property has two divergent styles of mineralization. One comprises nickel-cobalt-PGE in an ultramafic intrusion (see notes below). The other is disseminated gold in silicified zones within highly altered country rock. In 2012 the company drilled 16 holes (3 277 m) to test the distribution and tenor of gold mineralization. Typical assays were in the order of 1 g/t Au over 10 m.

##### *Cariboo*

Throughout 2011 Barkerville Gold Mines Ltd aggressively drilled their **Cariboo Gold Project** (almost 240 holes and 58 000 metres). In June 2012 they announced an NI 43-101 compliant resource with an estimated 10 million ounces of gold, supplemented in August by a report substantiating their news release. BC Securities Commission reviewed these releases and, citing technical disclosure concerns, issued a cease trade order. The company reports that it has been working diligently to prepare a satisfactory report. At the request of one of its consultants, the company drilled a further 14 holes (~2 760 m), 9 of which twinned previous holes.

##### *Chilcotin*

In October, Sona Resources Corp. received a special use permit that authorizes the construction of a ~5 km of access road to connect the **Elizabeth** mesothermal gold-vein deposit (developed prospect) and **Blackdome** epithermal gold-vein deposit (past producer). Road

construction is expected to begin in 2013. The company reports that it has permits in place for a further 6 000 m of drilling.

Manado Gold Corp drilled the South and Bari zones on their **Clisbako** property, 125 km west of Williams Lake, to test the extent and tenor of mineralization in silica stockworks and breccias.

##### *Fraser River*

In January, Berkwood Resources Ltd regained control of the **Prospect Valley** property, located 30 km west of Merritt, and reissued a mineral resource estimate (NI 43-101 compliant) prepared by former optionee Altair Ventures Incorporated (now Altair Gold Inc). The North and South Discovery zones together have an inferred resource of approximately 10 million tonnes grading 0.5 g/t Au (using 0.3 g/t Au cut off). Mineralization discovered to date is described as a low grade, epithermal gold system with potential for higher grade zones. In the summer, the company trenched and sampled and was successful in extending gold mineralization for 1 km along the projected trend of the Discovery zone.

Westhaven Ventures Inc completed a 5.5 km IP survey and a 5 hole (778 m) drill program at the **Shovelnose** epithermal gold property located 30 km south of Merritt. One focus of interest was Tower Creek valley, a structural feature between the Tower and Mik zones. Drilling encountered zones of silicification and quartz stockworks in felsic tuffs, suggestive of an epithermal mineralizing system. Host rocks are felsic volcanics of the Cretaceous Spences Bridge Group. Westhaven is working to earn up to 70% interest in the property from Strongbow Exploration Inc.

##### *Okanagan*

Gold Mountain Mining Corporation conducted an aggressive exploration program on their **Elk** project, located 45 km east of Merritt and just 2 km south of the Okanagan Connector (Highway 97C). Exploration included diamond drilling (~13 000 m), IP, and bulk sampling. The property has at least nine separate zones of mineralization. In several of them, gold occurs in quartz-pyrite veins within equigranular, coarse grained, mid-Jurassic granite. The company began bulk sampling in an area of previously delineated mineralization east of the past producing Siwash North open pit. Late in 2012, the company filed an application under the *Mines Act* to increase production from 10 000 tonnes to 70 000 tonnes per year.



#### 4.4.4 Stratiform Sulphide Projects

##### *Thompson River - Shuswap Lake*

Northeast of Barriere, Astral Mining Corporation optioned two large groups of claims from owner David J. Piggan. Geophysical surveys were flown over both the **Barriere Ridge** and **Honeymoon** properties. Drill targets are being identified. Prospective lithologies include Eagle Bay Assemblage (Figure 4.6) and contacts with the Cretaceous Baldy batholith.

Cullen Resources Limited completed a 6 hole (463 m) drilling program on the **TL** property, south of Tsuius Creek, 8 km east of Mabel Lake (Figure 4.7). Trenching in 2011 revealed a 3 m zone grading 9% Zn. Drilling intersected pyrrhotite, pyrite and sphalerite in multiple zones up to 1 m thick within a sequence of calc-silicates and graphitic quartzites. Gossanous subcrop ~300 m to the south yielded 2.25% Zn and anomalous Re, Mo and Cu. Drilling took place at the northern end of a large conductor and magnetic anomaly outlined from a HeliTEM survey. More work is planned for 2013.

MatNic Resources Inc drilled 3 holes (869 m) on their **Shuswap** property, 18 km east of Salmon Arm, an area that has not seen exploration activity in some time. The company tested airborne electromagnetic anomalies and surface showings of base metal mineralization, within schists of the Shuswap metamorphic complex, near the Annis adit (MINFILE 082LNW 023). The best intersection was 6 m of ~1% Pb, ~1% Zn and 10 g/t Ag.

#### 4.4.6 Magmatic Projects

##### *Thompson River - Shuswap Lake*

Commerce Resources Corp. reported progress on its **Blue River** project, tantalum and niobium bearing carbonatite, 30 km north of Blue River. The company continued metallurgical studies reporting satisfactory results. Field work consisted of structural geology reviews, in order to refine models used for resource calculations, and re-logging selected diamond drill cores. A mineral resource update, supplementing a 2011 Preliminary Economic Assessment, was released in July 2012. A further update which will include all data collected on the property is expected in early 2013.

Planet Mining Exploration Ltd continued work on their **Golden Loon** property, located 8 km west of Little Fort. The company is pursuing two targets: one comprises gold in silicified zones (see notes above). The other is nickel-cobalt-platinum group elements in a large, zoned, Alaskan-type ultramafic intrusion. In March the company reported elevated Ni-Co-Ag-Pt in samples of core drilled



Figure 4.6. Prospector Dave Piggan examining sulphide rich outcrop in Eagle Bay Assemblage (image courtesy of Astral Mining Corporation).



Figure 4.7. TL property east of Mabel Lake: drilling and core (Colin Dunn photos).

in 2008 but which had been incompletely analyzed. Metallurgical studies are planned.

## ***Similkameen River***

Near Tulameen, private company Magnetite Ridge Metals and Minerals Ltd of Kamloops, continued to investigate its large magnetite deposit located at its **Magnetite Ridge** project within the Tulameen Ultramafic Complex. The company reports that metallurgical studies conducted by UBC / BC Mining Research on a large composite sample, grading 30% magnetite, indicate its suitability as both steel smelter feed and coal cleaning heavy medium. The company has applied for a mining lease covering 1.5 sq km. The company also began exploration for potential placer platinum deposits in nearby Champion Creek.

## **OUTLOOK FOR 2013**

Mining operations should officially commence at the Bonanza Ledge and Basin Coal projects.

As mine evaluation projects submit required baseline studies, the next stages of the review process will be triggered. A Federal decision on New Prosperity is expected in 2013.

Most of the exploration projects that were active in 2012 have generated positive results and thus remain on track for advancement, barring downturns in metal markets or crises in international finance. If markets improve, grassroots exploration should pick up in the Eagle Bay Assemblage near Barriere and in the Quesnel terrane between Merritt and Princeton.

# EXPLORATION AND MINING IN THE SOUTH-WEST COAST REGIONS, BRITISH COLUMBIA

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## 5.1 SUMMARY AND TRENDS

This report covers the provincial government's Coast Area natural resource sector, comprising the South Coast and West Coast regions including Haida Gwaii. The area has one major metal mine, Myra Falls, and one coal mine, Quinsam, in operation for 46 years and 26 years respectively. Both have active exploration programs as they had in 2011. There are also numerous industrial minerals and aggregates operations in the region serving local and international markets.

Overall there were fewer major exploration projects in 2012, but while many junior companies deferred exploration plans in 2012, total exploration expenditures in the South-West Coast Regions were very similar to last year at approximately \$17 million (Figure 5.1). Exploration drilling is recorded at just over 30 000 m (Figure 5.2). Based on voluntary reporting in the Regional Geologist's informal survey, at least \$6.5 million of the exploration spending total was attributable to environmental studies and monitoring on projects that were at or near production decisions and making application for necessary permits and environmental certification. Larger exploration projects at or around the major mines also continued (Figure 5.4). Coal dominated exploration expenditures, along with large projects at Myra falls Operations and in the Island Copper district (Figure 5.5).

While venture capital funded projects have felt the effects of market conditions, changes to the Mineral Tenure Act Regulations in 2012 designed to encourage assessment work and reporting are likely having the desired effect in encouraging preliminary and small scale exploration programs.

Bear markets notwithstanding there were some major advances in 2012:

- NorthIsle Copper and Gold Inc explored the Island Copper properties and produced a new resource estimate for the Hushamu deposit;
- On-lease exploration continued at Myra Falls;
- Hillsborough Resources Ltd developed Quinsam 7 South and explored at its Quinsam East property;
- Regional and McMaster Zone exploration continued at the New Carolin Gold Corp's Ladner Gold Project. The project also moved

ahead in terms of metallurgy, updated resource estimates and proposed re-processing of tailings;

- Compliance Energy Corporation's Raven Underground Coal Project received its terms of reference for environmental assessment;
- Nearly all major mines and quarries continued producing at or near recent levels.

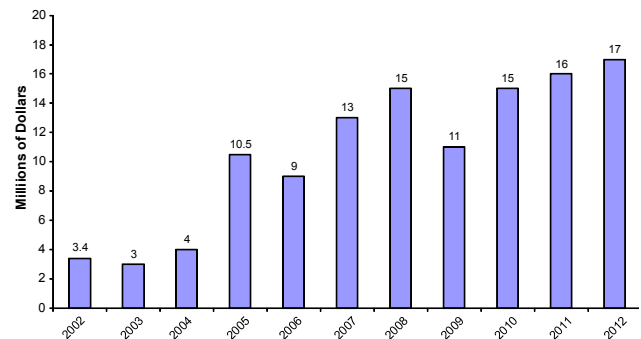


Figure 5.1. Exploration spending estimates for the South-West Coast Regions 2002-2012. The addition of Haida Gwaii to the region in 2010 had negligible impact on the statistics.

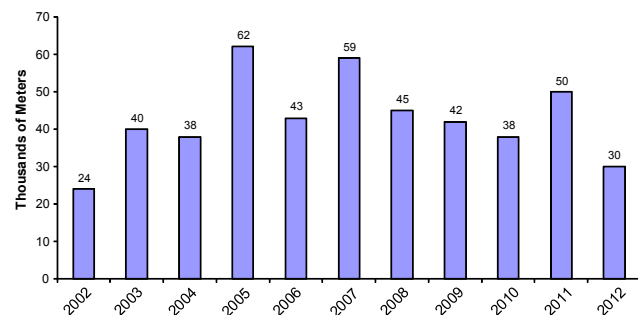


Figure 5.2. Exploration drilling in the South-West Coast Regions 2002-2012.

## 5.2 MINES

The location of operating mines and selected exploration projects are shown in Figure 5.3. Mine production and reserves statistics are given in Table 5.1.



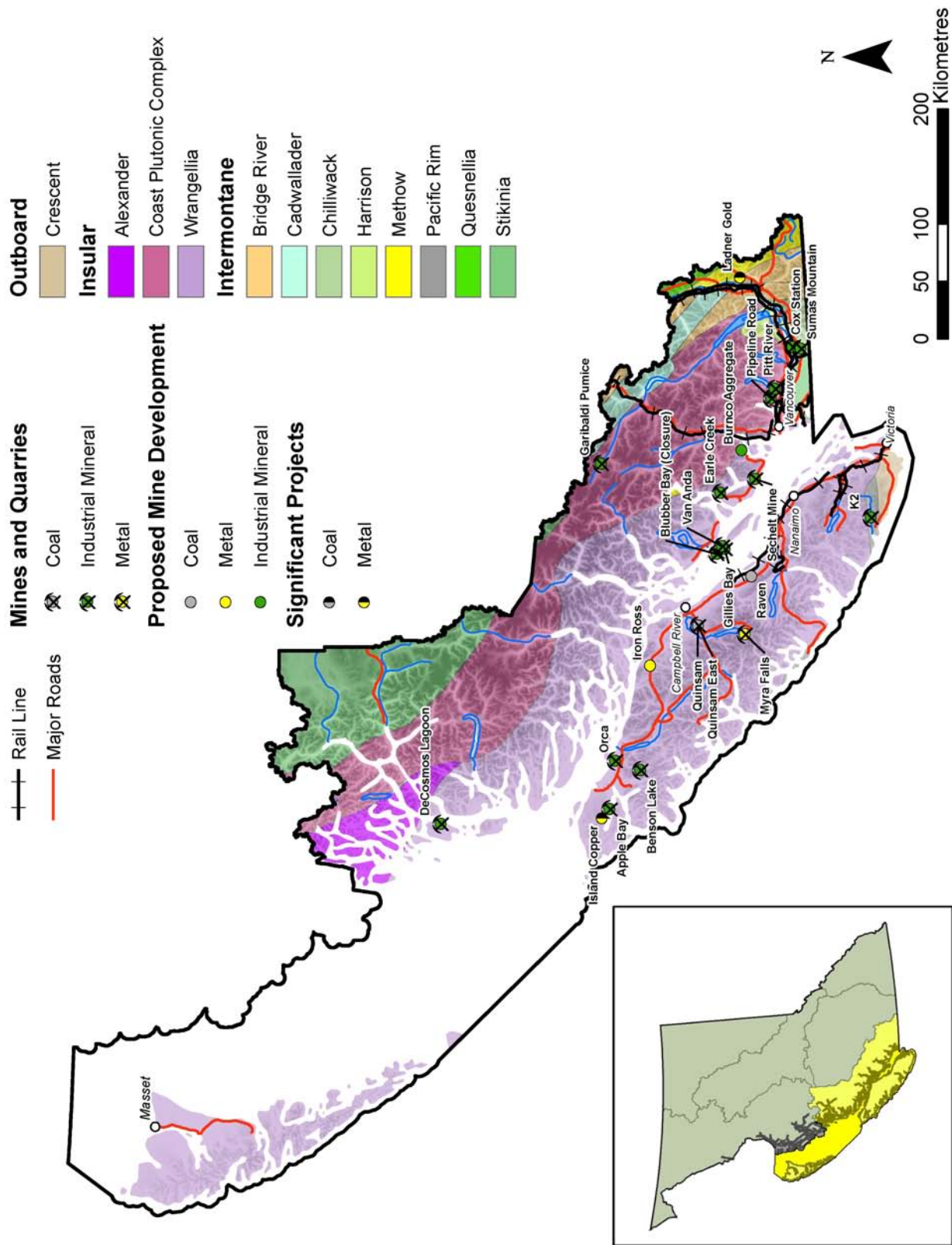


Figure 5.3. Operating mines and selected major exploration projects in the South-West Coast Regions, 2012.

**TABLE 5.1. RESERVES, FORECAST MINE PRODUCTION, SOUTH-WEST COAST REGIONS, 2012**

Mine	Operator	Commodities	Mine Workforce	Forecast Production 2012	Production 2011	Reserves as of Dec 31, 2011
<b>Metals</b>						
<b>Myra Falls Operations</b>	NVI Mining Ltd (Nyrstar N.V.)	Zn-Cu-Pb-Au-Ag	282 +contractors	Approximately 0.5 Mt mill throughput head grades: 7.26% Zn, 0.55% Pb, 1.03% Cu, 1.29 g/t Au, 48.49 g/t Ag	494 kt ore milled 36 000 t Zn 4 200 t Cu 800 t Pb 385.7 kg Au 17 853 kg Ag (metal in concentrate)	6.25 Mt 4.75% Zn 0.46% Pb 0.87% Cu 1.35 g/t Au 43.87 g/t Ag (proven+probable)
<b>Coal</b>						
<b>Quinsam</b>	Quinsam Coal Corp (Hillsborough Resources Ltd.)	Thermal coal	approx 140	365 000 t clean coal	480 000 t clean coal	N/A (Developing 5,10,15 year plans)
<b>Industrial Minerals</b>						
<b>Apple Bay (PEM 100)</b>	Electra Gold Ltd.	Chalky geyserite	8	Approx 50 000 t	49 248 t	~5 million t
<b>Benson Lake</b>	Imasco Minerals Inc.	White marble	4	36 300 t	26 000 t	100+ year
<b>Blubber Bay</b>	Ash Grove Cement Company	Limestone aggregate, dolomitic limestone	Care and Maintenance 2011-2012			100+ year
<b>Garibaldi Pumice</b>	Garibaldi Pumice Ltd.	Pumice	4	21 500 m3	5 200 t	100+ year
<b>Gillies Bay</b>	Texada Quarrying Ltd. (Lafarge North America Inc)	Limestone, aggregate	70	4.2 Mt	3.3 Mt	100+ year
<b>K2</b>	K2 Stone Quarries Inc	Building Stone	4	16 000 - 18 000 t	16 000 t	N/A
<b>Monteith Bay</b>	Lehigh Hanson Inc.	Geyserite	Care and Maintenance 2008-2012			
<b>Mount Meager</b>	Great Pacific Pumice Ltd	Pumice		No 2012 production	500 t	100+ years
<b>Sumas Mountain</b>	Sumas Shale Ltd (Clayburn Industrial Group and cement manufacturer partners)	Sandstone and shale	10	~ 400 000 t	381 000 t	~70 years
<b>Van Anda</b>	Imperial Limestone Company Ltd (JA Jack & Sons Inc.)	Limestone	9	~ 250 000 t	227 000 t	50+ years

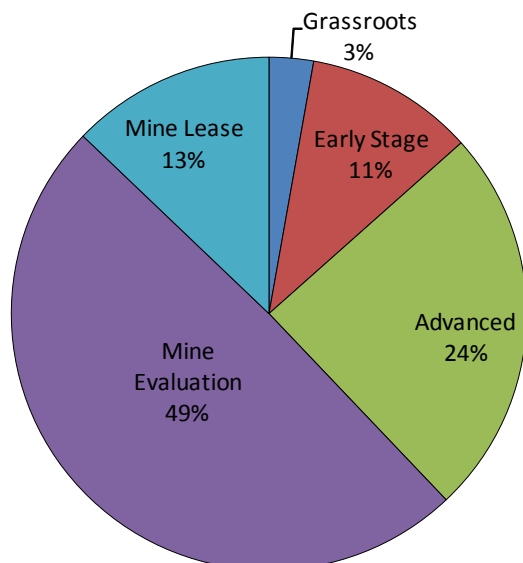


Figure 5.4. South-West Coast Regions exploration spending by exploration stage, 2012.

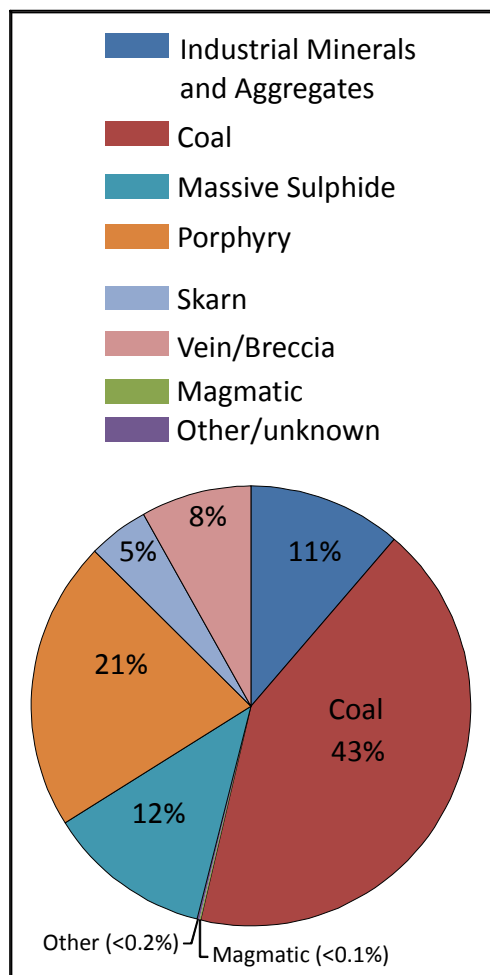


Figure 5.5. South-West Coast Regions exploration spending by primary target type.

## 5.2.1 Metals

The South-West Coast Regions' one major metal mine, **Myra Falls Operations** (MINFILE 092F 071-73, 330), located in Strathcona-Westmin Class B Provincial Park, continued to perform in line with its recent history and according to new owner Nyrstar NV's expectations. In the first three quarters of 2012 the operation milled 389 000 t at an average head grade of 7.26% Zn, 0.55% Pb, 1.03% Cu, 1.29 g/t Au, 48.49 g/t Ag. The mine is on track for approximately half a million tonnes throughput, similar to recent years. It employs 282.

Also consistent with the operation's recent history, there was approximately 20 000 m of underground drilling, mainly directed at finding extensions to ore bodies, or new lenses. An exploration track drift reached the Marshall zone in 2011. Drilling continued into 2012 until ground conditions in the drift temporarily interfered with exploration plans. However exploration drifts and drilling continues on other targets such as Ridge West and the Price mine. On-lease exploration at the mine is typically one of the largest exploration projects in the South-West Coast Regions. There are plans to step up the exploration program even further in the coming year in an effort to build reserves for a long term mine plan. Starting with a small open pit at the Lynx deposit in 1966, the operation has a history of success in replacing reserves. Limited tailings storage capacity is more likely to ultimately limit mine life than exhaustion of reserves.

As reported in this publication and elsewhere last year, Myra Falls has been the site of successful proof of concept testing of a new geophysical exploration technique. Muon geotomography uses sensors placed underground and cosmic rays to produce a three dimensional image of the earth's density distribution at up to one kilometer depth. Based on the research of UBC physicist Douglas Bryman, the concept is somewhat similar to medical or industrial applications of computed tomography, but it uses a naturally-occurring muon flux. It has been successful at Myra Falls in identifying massive sulphide bodies, which differ significantly in density from their host rock. Currently the technique is suitable for underground mine-site exploration, as it requires passageways capable of accommodating large sensors. Advanced Applied Physics Solutions Inc. is commercializing the technique.

The deposits are hosted in the Middle Paleozoic Sicker Group volcanics, an oceanic arc assemblage forming the basement of Vancouver Island. Devonian Myra Formation rocks host the mineralization at Myra Falls, which is in the Buttle Lake uplift, where Sicker Group basement is exposed along a northwest trending antiform roughly in the centre of Vancouver Island. Ore bodies are found in two horizons in the Myra Formation. The Myra Falls camp is generally considered a Kuroko-type or bimodal felsic type VMS environment.



## 5.2.2 Coal

Nearer the top of Vancouver Island stratigraphy, the **Quinsam Thermal Coal Mine** (MINFILE 092F 319) near Campbell River has been in operation since 1986 and is currently the only active coal mine in the South-West Coast Regions. It is the only underground coal mine in the province, though others are proposed, including the Raven underground metallurgical coal project near Comox. Vancouver Island has a history of underground coal mining dating back to 1849, and in terms of remaining resources it has the potential to continue many more years (Figure 5.6).

The Quinsam mine has focused on two coal seams of the Upper Comox Formation, Part of the Upper Cretaceous Nanaimo Group, producing approximately half a million tonnes per year. They anticipate somewhat less, approximately 365 000 t of clean coal in 2012. The mine supplies local cement plants and increasingly the Pacific thermal coal market since Hillsborough Resources Ltd. became part of the Vitol Group, an international energy trader.

In early 2012, Quinsam obtained a permit and began developing 7 South, a new area approximately 3.5 km by road from the previous mine site. Some production now comes from the new area (Figure 5.7). There are additional resources in the adjacent Quinsam North area reported under previous management, which could extend mine life many more years at the current rate. Hillsborough is now a private company and does not publish annual estimates of reserves and resources.

The company has been testing and researching underground waste and tailings disposal for several years. It is now permitted to dispose of coarse waste underground. In 2012 the mine disposed 120 000t of potentially acid generating coarse coal rejects in flooded workings.

In one of the significant exploration projects on Vancouver Island, there was exploration drilling at Quinsam East in 2012, approximately 8 km from the current mine site. Coal was intersected in the current drill program as it was in a 2010 phase of drilling and in the area historically. Results of the recent program are not published (Figure 5.8)

## 5.2.4 Industrial Minerals

Large quarries on the coast are well placed to serve Lower Mainland, Vancouver Island and US Pacific Northwest markets by barge. Those with access to freighter loadout facilities can also supply Pacific international markets. Most of the companies mentioned in this section maintain websites with product specifications to which the reader is referred for more information.



Figure 5.6. The concrete headframe of the Morden Mine, built in 1913. Though it was not a particularly successful operation (it closed in bankruptcy in 1921), it stands as a reminder of a previous era of coal mining on Vancouver Island which began in 1849. Vancouver Island's coal resources are far from exhausted. The Morden Mine itself may have as much as 7 million tonnes resources (but is located in a park in a rural/residential setting).



Figure 5.7. Site preparation of the 7 South area at Quinsam. A coal seam is exposed in the centre of the frame.

The largest limestone quarry on the coast is **Texada Quarrying** operation near Gillies Bay (MINFILE 092F 395). Texada Quarrying Ltd is a subsidiary of Lafarge North America. Most of its projected 4.2 million tonnes in 2012 goes to local cement plants. The quarry also produces aggregate, mainly from dykes, which would otherwise go to waste. On the site is also a white carbonate quarry, one of only a few sources on the coast. Texada Quarrying is in planning stages of an on-lease exploration program, likely commencing early in the New Year. (Figure 5.9, 5.10)

The Imperial Limestone Co. Ltd. quarry near **Van Anda** (MINFILE 092F 394) on Texada Island will produce approximately 250 000 t in 2012. The product is barged to parent company J.A. Jack & Sons Inc. in Seattle where it is processed and distributed for a wide variety of potential end uses. Currently much of the product is used in glass making and roofing manufacture. The white products have applications as fillers and extenders. Agriculture is also a major use of limestone with applications including soil sweeteners, animal feed additive, acid neutralization and environmental remediation. There has been quarrying at the Imperial site since the 1930's. Current owners have operated it



Figure 5.8. Rig preparing for drill move at Quinsam East.

since the early 1950's. They anticipate reserves will last in excess of a further 50 years (Figure 5.11).

Ashgrove Cement Company's **Blubber Bay** limestone quarry (MINFILE 092F 479) on Texada Island is on care and maintenance, but may resume for individual contracts. Its products are limestone and dolomite.

On Northern Vancouver Island, Electra Gold Ltd. continued to mine chalky geyserite at the **PEM 100** or **Apple Bay Quarry** (MINFILE 092L 150) in 2012. Production is similar to the past few years at roughly 50 000 tonnes. Since 2003 the product has gone mainly to Ash Grove Cement Company in Seattle for use as alumina silica source in cement manufacture.

Also on Northern Vancouver Island, Imasco Minerals Inc. increased sales of its **Benson Lake** (MINFILE 092L 295) white carbonate. Quarry production is expected to be approximately 36 300 t, representing an increase over last year. The product has a high dry brightness (95) and is used mainly as a white  $\text{CaCO}_3$  filler and extender, available in a number of size gradations from Imasco's Surrey location. The carbonate is barged to Surrey from Port Alice.

The **Sumas Shale** quarry on Sumas Mountain (MINFILE 092GSE024, 092GSE004) is owned by Clayburn Industrial Group Ltd, operated by contractor Fraser Pacific Enterprises Inc and delivers its sandstone

and shale product to cement plants in Richmond and Seattle through a joint venture with Lafarge North America (Sumas Shale Ltd). The quarry is on track to produce approximately 400 000 t in 2012. Since Clayburn's brick and refractory products plant closed in Abbotsford, fireclay is no longer produced separately.

The Ironwood Clay Company Ltd. reports sales up 100% this year. Its increasing exports to Korea and China together with British and American sales made it a winner in the 2012 BC Export Awards in the Consumer Products category and earned it about \$10 million in sales. Their products are based on glacial marine clay mined on the Central Coast. Recent production has been from **DeCosmos Lagoon** (MINFILE 092M 019) south of Bella Bella. That site will be reclaimed and Ironwood will move production to Hvidsten Point. Ironwood's manufacturing facilities are in Richmond.

Others supply the growing cosmetic clay market at smaller scales from locations on the Central Coast and Vancouver Island. Generally, no Mines Act permits are required where material is collected by hand and typically these small quantities are not reported.

Materials marketed as cosmetic clays are generally mixtures. Cosmetic clays are said to have cleansing properties, exfoliating the skin, absorbing oils and adsorbing other contaminants. Clays from some deposits elsewhere in the world have antibacterial properties which make them suitable for medical applications.

In the Mount Meager area, Garibaldi Pumice Ltd produced 21 500 cubic meters of mainly coarse pumice at its **Garibaldi Pumice** quarry (MINFILE 092JW 039). The majority of pumice is used as lightweight fill, but it also used in lightweight concrete, landscaping and horticulture (including green roofing). Pumice may have additional applications including fillers, grinding compounds, cosmetics.

Garibaldi reported a program of exploration test pits which extended the deposit in measured and indicated categories by 8.2 million  $\text{m}^3$  (coarse pumice) over a 2.35  $\text{km}^2$  area. There is an additional inferred 6.8 million  $\text{m}^3$ , plus additional finer material. These findings support the visitor's visual impressions of a large potential pumice resource in the general Mount Meager-Plinth Peak area.

Neighbouring Great Pacific Pumice Inc (MINFILE 092JW 040) did not produce at their **Mount Meager** quarry but utilized existing stockpiles in 2012.

K2 Stone is a vertically integrated natural stone product supplier with quarries on Vancouver Island, near Port Renfrew (**K2**, MINFILE 092C 159) as well as Montana. K2 quarries, processes and distributes their products. Their Ocean Pearl colour comes from the Port Renfrew quarry which is expected to produce 16-18,000 t in 2012, similar to the past two years.

There are smaller producers of slate also quarrying slates of the Leech River Complex. **Van Isle Slate**





Figure 5.9. A view of Texada Quarrying's mine near Gillies Bay.



Figure 5.10. Texada Quarrying's ship loading facility.



Figure 5.11. A barge is loaded at Imperial Limestone's quarry near Van Anda.



(MINFILE 092C 154) is another such producer which has started from a very small operation over the past few years offering a line of hand cut products.

Matrix marble and Stone continues to quarry marble on Vancouver Island and fabricate a line of products including countertops, sinks, tiles and building products. They quarry their Carmanah Black near Port Renfrew (**Gordon River** MINFILE 092C 086) and Tlupana Blue Grey and Vancouver Island White near **Hisnit Inlet** (MINFILE 092E 020).

Landscaping stone is quarried in the Sea-to-Sky Corridor. The largest operator is Northwest Landscape and Stone Supply, with its **Spumoni Quarry** (MINFILE 092GNW100) and other sites, some of which are to be upgraded to full mining leases.

**Haddington Island** (MINFILE 092L 146) and **Hardy Island** (MINFILE 092F 425) are two small but regular producers of dimension stone on the coast. The Haddington Island product is a durable, resistant Miocene volcanic rock (70.5% silica) with a dry crushing strength of 18 428 psi, valued for its ability to sustain carving and hold edges. Hardy Island produces a uniform grey Coast Plutonic Complex granodiorite used mainly for residential and commercial construction. The Haddington Island and Hardy Island products are available through Adera Natural Stone Ltd and Bedrock Granite Sales, respectively, along with other local products.

Alpine Natural Stone Ltd also quarries stone in the Squamish-Whistler corridor at several locations. Elsewhere, several small quarrying operations proceed with bulk samples. Up to 10 000 t may be extracted without upgrading tenures to leases, allowing test marketing and small scale production.

Construction aggregates account for a large proportion of the mining business on the coast. The area hosts some of the largest aggregate pits and quarries in Canada. The availability of water transportation is a factor in the million tonne per year and larger operations, making shipment of this low unit value commodity more efficient than by overland means. The large majority of production is for local use, but aggregate continues to be exported to markets in California and Hawaii where local supply cannot meet demand.

The construction materials industry's two largest participants on the coast are also two of the world's largest: Lafarge North America and Lehigh Hanson. Number three is a local company, Mainland Sand and Gravel Ltd. followed by a number of smaller companies and individual operations. The aggregates industry is a major contributor to the provincial economy and perhaps overlooked as such. It is also necessary for residential, commercial and infrastructure construction and maintenance. According to BC Energy, Mines and Natural Gas and Natural Resources Canada, over 40 million tonnes were produced in 2011, with an estimated value of nearly \$350 million. The majority of this production and use occurs on the coast, with some

exports, generally from three of the largest mines. There are hundreds of producing pits and quarries in the region. Only a few of the largest are profiled here.

One of the largest aggregate-only mines on the coast is the **Sechelt Mine**, operated by Lehigh Hanson. The company no longer makes production figures public, but volumes have been in the 3-5 million tonne range in recent years. A ship loading facility capable of accommodating Panamax class freighters handles most shipments.

Lafarge North America's **Earle Creek** (MINFILE 092GNW102) operation will produce 1.35 million tonnes in 2012 and employs 30. Product is shipped by barge. **Pitt River Quarries** (MINFILE 092GSE007) will produce 1.45 million tonnes and employs 45. Product moves by truck and by barge.

Other large Lafarge aggregate operations in 2012 include:

Central Aggregates (Bradner Road Abbotsford) 850 000 t, 25 employees

Ward Road (Sumas Mountain), 850 000 t, 25 employees

Coquitlam (Pipeline Road) 400 000 t, 20 employees

Also on Pipeline Road are large operations by Jack Cewe Ltd and Allard Contractors Ltd. Together they produce in excess of one million tonnes per year.

For the nine months ended September 30 Polaris Minerals Corporation produced and sold over 1.5 million tonnes at its **Orca Quarry** (MINFILE 092L 220) near Port McNeill. The quarry is on track to produce and sell approximately 2 million tonnes in 2012.

Mainland Sand and Gravels Ltd's largest operation is the **Cox Station Quarry**, located on the north side of Sumas Mountain and another of the area's largest operations. The product is a crushed quartz diorite. Over 90% of the 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. In recent years, production has been in excess of 2 million tonnes per year.

### 5.3.1 Mine Development

There are no major new mining projects in the South-West Coast Regions in development. However, as described above, the development of 7 South at Quinsam should see the operation continue at approximately the same rate for a period of several years, after which adjacent resources may be developed. Nyrstar undertook considerable underground development at Myra Falls, most of which is initially used for exploration drilling and subsequently will serve production if successful.

New aggregate quarries are developed and expansions occur regularly. Only the largest, such as

described below, are generally recorded in this publication.

### 5.3.2 Mine Evaluation

There are two major South-West Coast Region mining projects in the pre-application phase of Environmental Assessment, a proposed coal mine and a large aggregate operation. In addition a small magnetite mine is proposed on Vancouver Island.

The **Raven Underground Coal Project** (MINFILE 092F 333) is a proposed mine south of Comox on Vancouver Island. As projected in the feasibility study the main product is to be a semi soft coking coal with a thermal by product. Forecast production is approximately 830 000 t clean coal per year over 16 years. Compliance Energy Corporation, the majority partner in the Comox Joint Venture is focused on getting the project beyond pre-application and into Environmental Assessment and the majority of 2012 pre-development work on the Raven is directed toward that objective with environmental studies and public consultation. Work also continued on the project's feasibility study. The project received its terms of reference (Application Information Requirements for the EAO and Environmental Impact Statement Guidelines for the CEAA) in June 2012, which allow it to assemble and submit its applications for environmental certification. (Figure 5.12)

The **BURNCO Aggregate Project** in the McNab Creek Valley is also in the pre-application stage of environmental assessment with both the provincial and federal agencies. That proposed mine would ramp up to a 1 million tonne-per-year operation, initially barging product to BURNCO's ready-mix concrete plants in South Burnaby and Port Kells.

Work on the project in 2012 consisted largely of environmental monitoring and modelling. A smaller component of this year's efforts consisted of project design and engineering.

Near Sayward, Canadian Nexus Ventures Ltd. and Canadian Dehua International Mines Group Inc. are planning to re-open a small magnetite operation which last produced continuously in the 1960's and briefly in 2005, when a 4800 tonne bulk sample was used for X-ray shielding concrete. The **Iron Ross** project includes a cluster of magnetite skarn deposits (MINFILE 092K 043). The proponents have made application for a 70 000 tonne-per year operation. The mine plan describes basic quarrying, crushing, magnetic separation and trucking to Kelsey Bay (Figure 5.13).

Iron Ross deposits occur along a contact between Upper Triassic Karmutzen Formation basalts and overlying Quatsino Formation limestone. They are among numerous iron skarns on the coast hosted by Vancouver Group volcanics and carbonates.



Figure 5.12. Past producing Tsable River Coal mine in the foreground. In the upper right of the frame is the site of the Raven project.



Figure 5.13. Old quarry site with massive magnetite at the Iron Ross project near Sayward. A new 70 000 tonne per year operation is proposed.

Work continues toward obtaining the necessary authorities to start an aggregate operation that would utilize waste dumps from another skarn deposit, the former **Tasu** mine (MINFILE 103C 003) on Moresby island (Figure 5.14). Coastal Construction Aggregates Ltd. plans to ship by barge from the Tasu Aggregate Quarry to markets on the coast. Product should be suitable for applications such as railway ballast, marine fill, armour and rip-rap and may find use in various port expansion projects. The original Tasu iron mine operated between 1967 and 1983, producing tens of millions of tonnes of largely limestone, marble, basalt and diorite waste rock in addition to more than 23 million tonnes of ore. Waste from past-producing iron skarns has served as aggregate before, with examples on Texada Island and the Brynnor mine near Ucluelet (MINFILE 092F 001).





Figure 5.14. View from the top of the waste pile at the former Tasu mine. Coastal Construction Aggregates proposes to utilize waste rock as aggregate.



Figure 5.15. Before and after repair shots of the core storage and logging area at the Abo gold project. Vandalism and theft are intractable problems at accessible locations. This core was apparently dumped to gain access to the rebar used in the racks.



## 5.4 EXPLORATION PROJECTS

Significant exploration projects are summarized in Table 5.2.

### 5.4.1 Coal Projects

The largest coal projects were the proposed Raven Underground Coal mine and exploration at Quinsam East, as discussed above.

### 5.4.2 Precious Metals

On the west central coast of Vancouver Island, Gonzaga Resources Ltd. continued a geochemical survey at its **Kennedy River** gold project in 2012 (MINFILE 092F 032, 392, 448). Initial results extend a geochemical gold target (G-1) to the west and they identify a separate area of elevated gold-in-soil results to the south-west.

Near Port Alberni the **Mineral Creek** project (MINFILE 092F 079, 331) changed hands in 2012 and now belongs to a private company, Lu'an Canada Capital and Energy Investment. The new owner has filed a Notice of Work and in 2012 completed a small soil geochemical survey to find surface expression of a high grade vein drill target.

St Elias Mines carried out a small project at its **Knight Inlet** property (MINFILE 092K 158, 161). Mineralization identified in the late 1980 and 1990's includes high sulphidation epithermal Au-Ag and Porphyry Cu-Mo occurrences.

Geochemical work is recorded for assessment on the **Ashlu** property (MINFILE 092GNW045,47,55,62) of Ashlu Mines Inc., a private company, which has assembled a land position around the former Ashlu Mine (MINFILE 092GNW013). Results of this year's work are not yet public. A rock, soil and silt sampling program has been ongoing for 3-4 years, successfully re-locating showings around the former mine. The Ashlu Mine is a past producer which exploited a narrow gold quartz vein (<1m to 4.6 m) over a strike length of 90m and 85 m down dip. In 1981 reserves were just under 90 000t of 8.57 g/t Au and 12.31 g/t Ag. The property is largely underlain by the Jurassic Cloudburst pluton, with a pendant of Gambier Group rocks in the southwestern portion of the property.

The **Abo**, or **Harrison Lake Gold** project (MINFILE 092HSW092) is located roughly 5 km northeast of the village of Harrison Hotsprings. The property was recently optioned by Sierra Madre Developments Inc doing business as Bear Mountain Gold Ltd. They have repaired the core logging/storage facility, rehabilitated the Jenner portal and conducted orientation soil geochemistry surveys (Figure 5.15 (above)). There is a five-year permit in place that allows for drilling.

In the deposit area Brokenback Hill Fm sediments and volcanic rocks are intruded by quartz diorite stocks. One of these, the Jenner stock, gives a sericite K-Ar age of Oligocene to early Miocene, reported in the BC Geological Survey's Geological Fieldwork 1984. Mineralization in the Jenner stock is characterized as disseminated pyrrhotite, minor pyrite, chalcopyrite and traces of molybdenite. The current exploration is based on an intrusion-hosted gold model (Fort Knox type Au).

Gold occurrences related to Tertiary quartz diorite or diorite stocks are also known to the southeast (**Blue Chip**, MINFILE 092HSW017) and northwest (**Doctor's Point**, MINFILE 092HNW071 probably **Providence**, MINFILE 092HNW030 and the **Fire Mountain** cluster of occurrences) close to the Harrison Fault. There was also a small program of geology and geochemistry at Doctors Point.

Near the north end of Harrison Lake, Electra Gold Ltd. optioned the **Golden Ridge** project, formerly the Quet or Hotspring Claims (MINFILE 092GNE027, 033, 038). Check assays on historical drill core were consistent with 1990 and 1997 results. Still at an early stage of exploration, the target is a near-surface low grade gold deposit. The company has submitted a Notice of Work and engaged archaeological consultants.

One of the more active properties in the area in 2012 was New Carolin Gold Corp's **Ladner Gold Project** (MINFILE 092HNW007, 008, 018 and others) east of Hope, which made several steps forward in 2012, including a new resource estimate, metallurgical work and continuing regional exploration and drilling at the McMaster Zone (Table 5.2).

One aspect of the project is an investigation of the economics of re-processing Carolin Mine tailings. A March 2012 preliminary economic assessment showed high price sensitivity with positive project economics above \$600/oz gold. At \$1100/oz gold the project was estimated to have NPV of \$8 million at a 5% discount rate (Figure 5.16)

Average recovery in the 1982-1984 Carolin Mine period of production was slightly better than 50%. At a cutoff grade of 1.0 g/t, the indicated resource is approximately 23,700 oz (Table 5.3). There is a further inferred resource (5000 oz) and a portion of the tailings (approximately 40%) which remain untested and not included in the estimate. New Carolin and Shoreline Resource Management Group have announced a Letter of Intent concerning the establishment of a modular plant at the site. Under the terms of the LOI, Shoreline would develop and build its own plant for 65% of proceeds.

To the south, the multi-year underground bulk sampling program continued at the **Silver Peak** high grade silver vein project, which includes the historic Eureka-Victoria silver mine (MINFILE 092HSW011). Ore is described as consisting mostly of a silver-rich tetrahedrite or fribergite in siderite. Homegold Resources Ltd is the operator.

**TABLE 5.2. SIGNIFICANT EXPLORATION PROJECTS SOUTH-WEST COAST REGIONS, 2012**

Property	Operator	MINFILE (NTS ref.)	Commodity	Deposit Type	Work Program	Meters Drilled
<b>Iron Ross</b>	Canadian Nexus Ventures Ltd/Canadian Dehua International Mines Group Inc	092K 043	Magnetite, Fe	Skarn	EN, FS	n/a
<b>Island Copper</b>	Northisle Copper and Gold Inc.	092L 173, 177 200, 240, 273	Cu, Mo, Au, Re	Porphyry Cu-Mo-Au	DD (18 holes); IP (70 km); G	5438.7
<b>Ladner Gold</b>	New Carolin Gold Corp	092HNNW007, 003, 018	Au	Veins	DD (15 holes); MS; GC; AB (434 line km); PF	1620
<b>McNab Valley</b>	BURNCO Rock Products Ltd	(092G.053)	Aggregate	Sand and Gravel	EN; FS	n/a
<b>Myra Falls</b>	NVI Mining Ltd (Nyrstar Mining N.V.)	092F 071,072,073, 330	Zn, Cu, Pb, Au, Ag	VMS	DD; UG: GP (muon geotomography)	20 000
<b>Quinsam East</b>	Hillsborough Resources Ltd	092F 319	Coal (thermal)	Sedimentary	DD; PD (15 holes)	1969.5
<b>Raven</b>	Comox Joint Venture (Compliance Energy Corporation, Itochu Corporation, LG International Corp)	092F 333	Coal (met +/- thermal)	Sedimentary	EN; FS	n/a



Figure 5.16. The Carolin Mine tailings pond. New Carolin Gold Corp proposes to re-process the tailings. The Carolin mine achieved only about 50% recovery. New metallurgical tests suggest much better recovery is possible.

**TABLE 5.3. LADNER GOLD PROJECT RESOURCE ESTIMATION**

	<b>Cut off</b>	<b>Indicated (tonnes)</b>	<b>Inferred (tonnes)</b>	<b>Grade (g/t)</b>	<b>Gold (grams)</b>
<b>Tailings</b>	1.00	445 378		1.83	815 000
	1.00		93 304	1.85	172 600
<b>McMaster Zone</b>	2.00		548 000	2.24	1 225 000
	0.50		3 575 000	0.69	2 474 000
<b>Carolyn Mine</b>	2.00		2 588 736	3.34	8 649 000
	0.50		12 352 124	1.53	18 886 000

### 5.4.3 Base Metals and Polymetallic

One of the largest projects on the coast in 2012 was the **Island Copper** project of Northisle Copper and Gold Inc (Table 5.2). The company has a large land package on northern Vancouver Island with several porphyry and epithermal style occurrences along a prospective belt that hosted the past-producing Island Copper Mine. Between 1971 and 1994, that deposit produced 345 million tonnes with average head grades of 0.41% Cu,, 0.017% Mo, 0.19 g/t Au.

The most advanced target at present is the **Hushamu** deposit (MINFILE 092L 240), the subject of 2012 drilling and a new resource estimate:

	<b>Mt</b>	<b>Cu (%)</b>	<b>Au (g/t)</b>	<b>Mo (%)</b>	<b>Re (ppm)</b>
<b>Indicated:</b>	304	0.21	0.29	0.010	0.55
<b>Inferred:</b>	205.6	0.18	0.26	0.008	0.38

This resource is now comparable in size to the neighbouring Island Copper past producer (MINFILE 092F 138), however with lower copper grades and higher gold. There is an untested IP anomaly to the northwest and the deposit remains open in the southeast. Northisle has begun preliminary engineering studies and expects to proceed with a preliminary economic assessment. A Notice of Work is in process for additional drilling. (Figure 5.17)

New Rhenium-Osmium molybdenite ages suggest the Hushamu mineralization is slightly older than that of Island Copper, and the geology and mineralogy and paragenesis as interpreted so far show the deposit is not directly comparable to Island Copper. Both deposits are however broadly similar in that they are related to Middle Jurassic Island Plutonic Suite intrusions of approximately the same age in Jurassic Bonanza Group rocks and they occur in a prospective belt north of the Holberg Fault.

This deposit shares some of the advantages of its Island Copper Mine predecessor in its proximity to tidewater, infrastructure and skilled labour. There are however potential disadvantages in an accessible location with overlapping interests and uses, as is a common theme in South-West Coast Regions projects.

Northwest of Gold River, Red Hut Metals Inc. filed a prospectus and technical report in 2012 based on a 2011 reconnaissance program including an airborne survey late in the year on their **Conuma** Property. The ground based program consisted of reconnaissance mapping, prospecting and rock and soil geochemistry.

Northeast of Gold River, another new property with a reconnaissance program in 2011 and 2012 is the **TIB**, recently optioned by Universal Ventures Inc. As is often the case in the densely forested region, new logging roads have revealed mineralization in an area of otherwise poor exposure. Following the discovery was a 585 line km airborne survey in 2011 and further prospecting, mapping, rock geochemistry and a 20-km closely-spaced 3D IP survey in 2012. Exploration is in a very early stage, but styles of mineralization so far include possible replacement and vein high grade copper-gold (for example 2.7% Cu over 3.5 m including 0.5 m >10 g/t Au) and stockwork showings spread over several hundred square meters. Drilling and trenching are proposed. The showings occur in Karmutsen volcanics, near an intrusive stock. Intrusives in the area are mapped as Jurassic Island Plutonic Suite. Previous operators believed known occurrences in the area (MINFILE 092E 050, 092F 401) were porphyry-related. (Figure 5.18)

World Organics Inc is re-negotiating an option agreement with Nahminto Resources Ltd regarding the **Macktush** property (MINFILE No 092F 012, 168, 221, 360). Results of 2010-2011 soil surveys, mapping, prospecting and rock sampling were published in 2012 and there was a remote sensing program on the property in early 2012. Drilling is proposed. The area of the **Rex** showing in the approximate centre of the property





Figure 5.17. Drilling in a snowstorm at the Island Copper Project (photo by J. Halle).



Figure 5.18. High grade copper-gold mineralization was discovered in a road cut on the TIB property north east of Gold River, prompting a grass roots exploration program in 2011-2012. (photo by J. Turner).

represents a porphyry Cu-Mo target, as yet untested by drilling (Figure 5.19).

To the south of Macktush is the **Nahmint** property (MINFILE 092F 140, 157, 092C 007 and others) where Snowfield Development Corp flew a 953 line km airborne magnetic and radiometric survey early in the year following a preliminary survey in 2011. In addition to hosting several skarn occurrences, Nahmint is also a porphyry target.

Golden Peak Minerals Inc filed technical reports on its **Columbia Shear** property (MINFILE 092F 282, 311, 339, 461) with results of 2011 and minor 2012 work, including a 261 line km airborne (VTEM and Magnetometer) survey. Of 10 reported showings on the property, half are described as volcanogenic, occurring in Sicker Group rocks. The company is seeking a TSX Venture Exchange listing.

To the south, and also with several VMS targets, Nitinat Minerals Corporation filed results of a small 2011 trenching and drilling program for assessment on its **Jasper** Property (MINFILE No 092C 080, 081, 088). Results are not public at the time of writing.

The **Okeover** or **OK** property (MINFILE No 092K 008, 057, 155, 092F 302) is owned 40% by Eastfield Resources Ltd, 60% by Prophecy Coal Corp. Work in 2012 consisted of additional soil geochemistry and rock sampling. The last drill program was in 2007. Since then, soil surveys, IP and ground-based magnetic surveys have identified new drill targets on this Cu-Mo porphyry prospect. An Inferred resource in the northern part of the property (North Lake Zone) remains open. Further drilling is permitted.

Near Pemberton, Clear Mountain Resources Corp. reported and followed up a 2011 airborne and mapping effort with additional mapping at the **Owl Creek** property (MINFILE 092JSE004,6,7,14). Skarn and disseminated Cu-Mo mineralization are known in the area and on the property. The primary target of the current program is porphyry Cu-Mo mineralization.

East of Harrison Lake, optionees of the **Cogburn** (MINFILE 092HNE307, 092HSW081, 092HNW041) and **Lekcin** (MINFILE 092HSW, 082, 143, 168) projects carried out small scale geochemical reconnaissance work in advance of planned and permitted drill projects based on targets generated in 2011. British Columbia's only nickel mine, the **Giant Mascot**, or **Pacific Nickel** Mine (MINFILE 092HSW 004,093, 125) operated in the area between 1958 and 1974, exploiting a number of pipe-like ore bodies. In total more than 4.3 million tonnes of ore were mined yielding 26.6 million kilograms of nickel, 13.2 million kilograms of copper and cobalt, silver and gold by-products. Owner Barrick Gold Corporation has no mineral exploration plans in the area, but proposes a ski resort at the former mine property.

Southeast of Hope, private company Savoy Ventures Inc flew an airborne survey over the **Big Range** property (MINFILE 092HSW145). The Hozameen Fault runs through the property and a felsic stock with arsenic, molybdenum and copper mineralization in quartz veins is known on the property.



Figure 5.19. Gossanous exposures in road cuts, copper-molybdenum showings, soil geochemistry and geophysics have lead to proposed drilling of a porphyry target at the Rex zone on the Macktush property.

### 5.4.3 Other Industrial Metals

The largest Iron Skarn project this year was the Iron Ross proposed mine, discussed above. Other large, advanced magnetite exploration projects were not active in 2012. The **Cogburn Magnesium** project was not active in the field, however the land package was assembled and the property optioned to a private company in 2011.

There was a small magnetometer survey at the past-producing **Argonaut** iron mine (MINFILE 092F 075). Results are not yet public. Similarly, results of a 7-hole drill program by private company Western Gateway Minerals Inc. at nearby **Bacon Lake** (MINFILE 092F 256), another iron skarn, are also not yet public, though operators indicate that both programs warrant follow-up.

In the same area, the **Camp Lake** magnetite project (MINFILE 092F 571) was not active in the field, however Compliance Energy Corporation reported results from the previous year's drilling and geochemical surveys. Highlights included a near-surface 8.9 m intercept of 58.36% magnetic iron, and an 8.4 m intercept of 41.35% magnetic iron. The property remains in the early stages of exploration.

### 5.4.4 Industrial Minerals

As described elsewhere in this report there has been exploration or other pre-development work at Lafarge's Texada quarry, the Garibaldi Pumice Quarry, Tasu Aggregate Quarry, and BURSCO Aggregate Project.

There were other, smaller projects as well. In one on Northern Vancouver Island, White Rose Holdings Ltd Conducted exploration work at the **Leo D'Or** marble quarry (MINFILE 092L 339), including a small 3 hole drill program and some re-habilitation of the quarry site. There was some production in 1993, and efforts to put the quarry back into production continue. As with decorative stone and many industrial minerals generally, the producer must evaluate not only the deposit but the market for their specific products. In the same area, Graymont Western Canada Inc had a small geochemical and geophysical program at Nimpkish Limestone (MINFILE 092L 349).

### 5.4.5 Public Geoscience

In a project funded by Geoscience BC and the Island Coastal Economic Trust, there was a large airborne magnetometer survey over part of Northern Vancouver Island, extending nearly to Port McNeill in the east and Zeballos in the west. In addition, there is a stream sediment sampling and re-analysis program covering the airborne survey area plus additional territory. Results are to be released in early 2013. This project complements

recent mapping by Graham Nixon and others of the BC Geological Survey.

Also in the South-West Coast Regions, as part of Natural Resources Canada's Targeted Geoscience Initiative 4, the Geological Survey of Canada, BC Geological Survey and UBC are collaborating on a study of the Giant Mascot Ni-Cu deposit, the origin and setting of which remain controversial.

## 5.5 OUTLOOK

A sluggish venture capital market stalled some interesting early stage projects in 2012, particularly those for which exploration drilling was to be the next phase. Should the market recover soon and convincingly, several of these are positioned to move ahead.

Larger, more advanced projects forged ahead, as was the case around the province. It is generally the case that projects heading toward feasibility studies, permitting and environmental certification become more expensive to operate than earlier stage exploration. There is an incentive to move ahead while economic information and data gathered to satisfy regulatory authorities remains valid. Proponents of the largest projects have stated their plans to proceed in 2013. NorthIsle Copper Gold expects to proceed with an economic assessment on Hushamu, exploration spending at Myra Falls is scheduled to increase, and Compliance Energy is due to submit its applications for environmental assessment. On the Mainland, New Carolin Gold is working toward a small operation to re-process tailings, which should eventually provide working capital to advance its exploration. Other promising projects will likely depend heavily on the availability of venture capital going forward.

At the very earliest stages of exploration, new regulations provide an incentive to conduct reconnaissance work as opposed to paying cash in lieu to maintain mineral properties. The end result should be additional grass roots discoveries and targets for more advanced exploration.

## ACKNOWLEDGMENTS

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# EXPLORATION AND MINING IN THE KOOTENAY-BOUNDARY REGION, BRITISH COLUMBIA

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## 6.1 SUMMARY AND TRENDS

Mineral exploration expenditures were less in 2012 than in the previous year, but the overall exploration expenditures in the Kootenay-Boundary Region increased significantly, due to the high level of activity in the East Kootenay coalfields. Total coal production also increased compared with 2011.

Highlights for the year included:

- major coal exploration drilling programs (Centermount Coal Ltd, Crows Nest Pass Coal Mining Ltd, Jameson Resources Limited, and Teck Coal Limited)
- detailed engineering studies for development of a frac sand operation at the Moberly Mine (Heemskirk Canada Limited)
- a major underground drilling program and resulting resource calculation upgrade for the J&L polymetallic deposit (Huakan International Mining Inc)
- gold exploration drilling programs in the Nelson area (Altair Gold Inc, Anglo Swiss Resources Inc, Emgold Mining Corporation, Excalibur Resources Ltd, and Hellix Ventures Inc)
- continued exploration for sedex mineralization in the Purcell Basin of the East Kootenays (MMG Limited, Omineca Mining and Metals Ltd, Providence Resources Corp/Eagle Plains Resources Ltd, Purcell Resources)
- gold exploration drilling programs in the Cranbrook area (PJX Resources Inc, Turnberry Resources Ltd)

Total exploration expenditures in 2012 are projected to increase to about \$55 million (Fig. 6.1). The commodities with the highest exploration expenditures were coal and gold. Exploration expenditures in 2012 can be broken down into stages as shown in Figure 6.2. An estimated 129 km of exploration drilling was carried out in the Kootenay-Boundary Region in 2012 (Fig. 6.3).

## 6.2 MINES

The Kootenay-Boundary Region hosts five large open-pit coal mines, and smaller operations for industrial minerals (Fig. 6.4, Table 6.1).

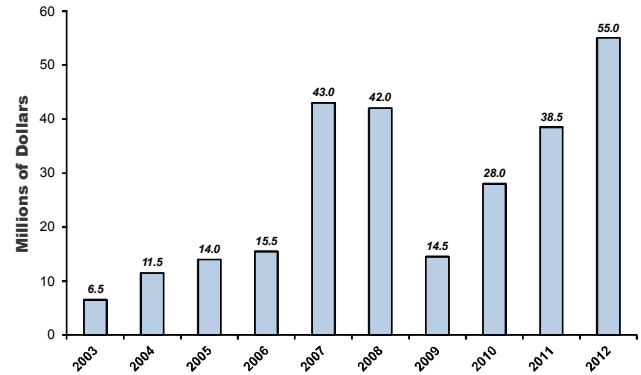


Figure 6.1. Annual exploration spending in millions of dollars, 2003 to 2012, Kootenay-Boundary Region. The Revelstoke area was added to the region in 2010.

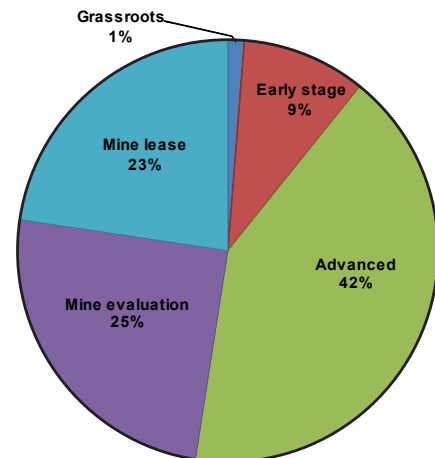


Figure 6.2. 2012 exploration expenditures by category, Kootenay-Boundary Region.

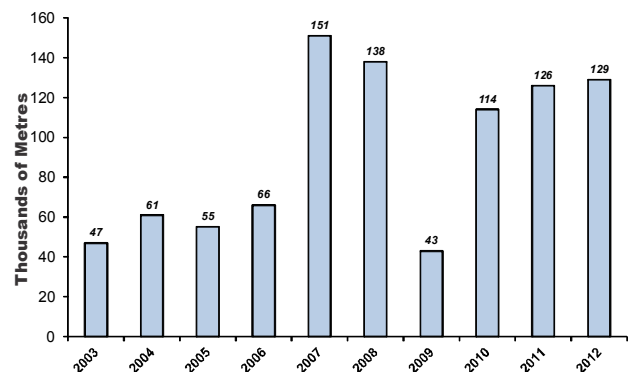


Figure 6.3. Annual exploration drilling in thousands of metres, 2003 to 2012, Kootenay-Boundary Region.

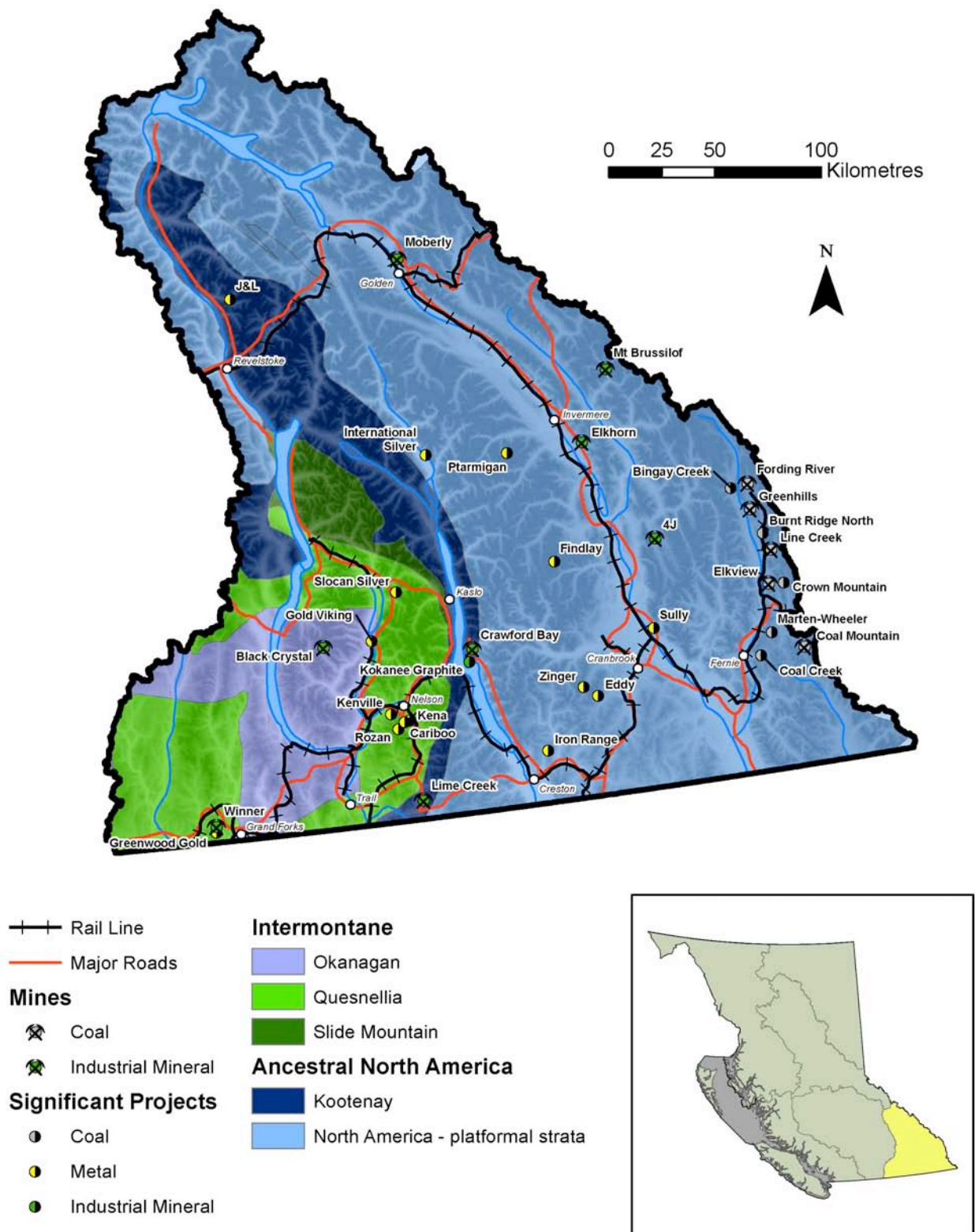


Figure 6.4. Locations of selected operating mines and exploration projects, Kootenay-Boundary Region, 2012. Large on-lease exploration drilling programs at three operating mines (Fording River, Greenhills and Elkview) are not plotted.

**TABLE 6.1. SELECTED PRODUCING MINES, KOOTENAY-BOUNDARY REGION, 2012**

Mine	Operator	Commodity	Employment	Actual 2011 Production	Projected 2012 Production	Proven and Probable Reserves as of December 31, 2011 or as indicated
<b>Coal</b>						
Coal Mountain	Teck Coal Limited	PCI and thermal coal	319	2.78 Mt	2.687 Mt	15.9 Mt
Elkview	Teck Coal Limited	Metallurgical coal	1067	4.167 Mt	4.653 Mt	215 Mt
Fording River	Teck Coal Limited	Metallurgical and thermal coal	1184	8.320 Mt	8.915 Mt	626.5 Mt
Greenhills	Teck Coal Limited	Metallurgical, PCI and thermal coal	577	4.421 Mt	4.544 Mt	75.3 Mt
Line Creek	Teck Coal Limited	Metallurgical, PCI and thermal coal	518	2.861 Mt	3.4 Mt	67.2 Mt
<b>Industrial Minerals (selected)</b>						
4J	Georgia-Pacific Canada Inc	Gypsum				
Crawford Bay	Imasco Minerals Inc	Dolomite				
Elkhorn	CertainTeed Gypsum Canada	Gypsum	17	423 kt	429 kt	
Lime Creek	Imasco Minerals Inc	Limestone				
Moberly Silica	Heemskirk Canada Limited	Silica sand				13.5 Mt @ 64% frac sand (June 30, 2012)
Mount Brussilof	Baymag Inc	Magnesite	42	190 kt	180 kt	
Winner	Roxul Inc	Gabbro (mineral wool)	2		150 kt	

## 6.2.1 Coal

Teck Coal Limited, the world's second-largest exporter of metallurgical coal, operates five large open-pit coal mines in the Elk Valley area. **Fording River Operations** (MINFILE 082FSE009, 010 and 012) is 17 km north of Elkford. **Greenhills Operations** (MINFILE 082JSE007) is 7 km northeast of Elkford. **Line Creek Operations** (MINFILE 082GNE020 and 021) is 25 km northeast of Sparwood (Fig. 6.5). **Elkview Operations** (MINFILE 082GNE013 to 017 and 023) is 5 km east of Sparwood (Fig. 6.6). **Coal Mountain Operations** (MINFILE 082GNE001) is 32 km southeast of Sparwood.

The Mist Mountain Formation (Jurassic-Cretaceous Kootenay Group) hosts commercially mineable coals in the Front Ranges of the Rocky Mountains in southeast BC. It occurs in three structurally separated coalfields, known collectively as the East Kootenay coalfields. These include, from north to south, the Elk Valley, Crowsnest and Flathead coalfields. The Elk Valley Coalfield is in the Alexander Creek and Greenhills synclines, and includes the Fording River, Greenhills and Line Creek operations. The Crowsnest Coalfield coincides with the Fernie Basin, a broad north-trending synclinalorium. It has hosted coal mining since before the turn of the twentieth century and includes the current Elkview and Coal Mountain operations. The Flathead





Figure 6.5. View looking north of Burnt Ridge South pit highwall at Line Creek Operations (Teck Coal Limited).

Coalfield consists of four relatively small, isolated exposures of Kootenay Group in the extreme southeast corner of the region. Because of provincial legislation that prohibits subsurface resource exploration and development in the Flathead Valley, the Flathead Coalfield and part of the Crowsnest Coalfield are excluded from coal mining activity.

The Mist Mountain Formation averages 500 to 550 m in thickness in the Elk Valley and Crowsnest coalfields, and at almost any location includes several coal seams of potentially mineable thicknesses. With the exception of Coal Mountain Operations, all of the mines produce from multiple seams. Coal seams are typically medium-volatile bituminous in rank, with some high volatile-A bituminous coals near the top of the section. Locally, low-volatile bituminous coals occur in the basal part of the section.

Total 2012 clean coal production at Teck Coal Limited's operations in the East Kootenays is projected to be 24.2 Mt. This compares with an actual production total of 22.55 Mt in 2011. The mines have 3665 full-time employees and make a major contribution to the East Kootenay and provincial economies. Proven and

probable raw coal reserves at the five mines are very significant (Table 6.1).

Hard coking coal is the predominant product at four of the five Elk valley mines, the exception being Coal Mountain Operations. Two or more products are marketed by each of these four operations, generally based on variations in volatile matter and/or ash contents. Products are typically medium-volatile bituminous in rank, and contain 8.6 - 9.5% ash. Sulphur is generally about 0.5%. Other attractive quality parameters include high Coke Strength after Reaction (CSR) test results. In addition to hard coking coal, Teck Coal Limited produces pulverized coal injection (PCI) coal, mainly from Coal Mountain Operations. Oxidized coal is also marketed as thermal coal in some cases.

## 6.2.2 Industrial Minerals

The Kootenay-Boundary Region continues to be an important source of industrial minerals and related products, including gypsum, magnesite, silica sand, mineral wool, dolomite, limestone, graphite, tufa,



Figure 6.6. View looking southeast at Natal Ridge at Elkview Operations (Teck Coal Limited). Natal 2 pit, now mined out, is in the foreground. Photo by Paul Jago.

flagstone, railroad ballast, rip rap, smelter slag and aggregate, but only selected larger operations are described here (Table 6.1, Fig. 6.4).

Baymag Inc produces high-quality magnesite from its open pit mine near **Mount Brussilof** (MINFILE 082JNW001), in the Rocky Mountains northeast of Radium. The Mount Brussilof deposit represents a large magnesium alteration zone in Cambrian carbonates. The operation has been in production since 1982. Ore is transported by truck to the company's processing facilities in Exshaw, Alberta for production of magnesium oxide (magnesia or MgO) and magnesium hydroxide (MgOH). Production in 2012 is projected to be approximately 180 000 t, a slight decrease compared with 2011. The processed products have a variety of environmental, industrial and agricultural uses.

Two gypsum mines operate in the Rocky Mountains portion of the Kootenay-Boundary region, both producing from an evaporite unit in the Devonian Burnais Formation. CertainTeed Gypsum Canada operates the **Elkhorn** Mine (MINFILE 082JSW021) east of Windermere, where production is mainly from the Elkhorn West Extension Pit. Production is projected to be approximately 429 000 t in 2012, a slight increase compared with 2011. Georgia-Pacific Canada Inc operates the **4J** gypsum mine (MINFILE 082JSW009) and rail load-out facility southeast of Canal Flats. There was no mining activity in 2012, and some shipments of stockpiled material were made from the load-out facility.

Silica sand is produced by Heemskirk Canada Limited at the **Moberly Silica** operation (MINFILE 082N001), in the Rocky Mountains 8 km north of Golden. The nearby plant and load-out facility is adjacent to Highway 1 in the Rocky Mountain Trench. Stockpiled product (previously processed material) was shipped to several markets in 2012.

The Moberly deposit is within a near-vertical quartzite unit in the Ordovician Mt Wilson Formation. It

is about 200 metres thick and is regionally extensive. The deposit itself comprises a 1000 m-long zone of variable friability, related to shearing and/or alteration.

In late 2011 the company reported the outcome of a feasibility study looking into the potential of producing frac sand for the western Canadian oil and gas industry. The study concluded that a commercial frac sand operation at the Moberly Mine and plant site is commercially viable. Estimated project capital cost is \$26 million. The investment is based on redevelopment of the current operation, including upgrading of the haul road and construction of a new processing plant.

In 2012 detailed engineering studies related to redeployment as a frac sand operation were undertaken, and at time of writing a 35-year mine plan had been completed, financing was being arranged, and a company decision was pending. During the year sufficient ore to commission the new plant was extracted and stockpiled at the plant site.

Measured plus indicated resources at the Moberly Silica mine site are estimated at 43.2 Mt of silica suitable for glass making, silica flour and other uses. A separate resource estimation specific to production of 64% frac sand (and 36% residuals suitable for other applications) yields 32.4 Mt in the measured plus indicated category. Ore reserves (proven and probable) of silica suitable for 20-mesh to 140-mesh frac sand are 13.5 million tonnes @ 64% frac sand.

Imasco Minerals Inc produces a variety of crushed and ground rock products at its Creston Operations Plant at **Sirdar** from limestone, dolomite, granite and quartzite rock types. Raw sources for these products include an underground dolomite mine at **Crawford Bay** (MINFILE 082FNE113), a limestone quarry at **Lime Creek** (MINFILE 082FSW307) southeast of Salmo, and a granite quarry at **Sirdar** (MINFILE 082FSE072). The carbonate units are Cambrian in age, whereas the granite is part of the Cretaceous Bayonne batholith.

The **Winner** gabbro quarry (MINFILE 082ESE265) west of Grand Forks supplies feed for the Roxul Inc mineral wool insulation manufacturing plant in Grand Forks. Extraction volumes in 2012 were sufficient for plant operations in 2012 and 2013.

Eagle Graphite Corp operates the **Black Crystal** flake graphite operation (Fig. 6.7). Graphite ore is produced from the quarry on Hoder Creek (MINFILE 082FNW260), 22 km west of Slocan City, and processed at the pilot plant near the confluence of Koch Creek and the Little Slocan River, 10 km west of the Slocan Valley village of Passmore. Host rocks are amphibolite-grade calc-silicates of the Valhalla gneiss complex. Mineralization, consisting of disseminated fine to coarse flake graphite, occurs over an area roughly 500 m square, and appears to occupy a zone with a minimum thickness of 80 metres. It occurs in two zones; a regolith zone overlies the "hard rock" zone. Most of the deposit, especially the regolith zone, is friable and blasting is not





Figure 6.7. Mine geologist Mike Glatiotis examines a trench in flake graphite-bearing calc-silicates on the Black Crystal property (Eagle Graphite Corp).

required. Acid rock drainage is not an issue due to the calcareous nature of the host rock.

In 2012 the company processed stockpiled ore and made a shipment of flake graphite to a customer as part of an off-take agreement. This represents the first such agreement for regular shipment of product.

## 6.3 MINE DEVELOPMENT AND EVALUATION

### 6.3.1 Mine Development

Approximately \$51 million was spent on mine development in 2012, predominantly in the Elk Valley, at Teck Coal Limited's five mine operations. Development activities in 2012 included: pre-stripping in permitted mining areas (for example, North Line Creek Extension); in-pit drilling (over 32 000 m) for refinement of reserve definitions, coal quality analysis, geotechnical analysis, and structural interpretation; and access and infrastructure construction.

### 6.3.2 Mine Evaluation

Mine evaluation refers to the exploration stage in which environmental, social, financial and engineering assessments and studies are undertaken, and applications are prepared and submitted for the Environmental Assessment Process (EAP) and/or the various permits required for statutory approval of a mining project. It includes technical assessment of the project, identification of potential impacts, and design of mitigation measures, and requires studies that examine wildlife, surface water, groundwater, geotechnical and other issues. More detailed

descriptions of some of the projects mentioned in this section are found with the corresponding mine and/or exploration property descriptions.

Two East Kootenay coal mine expansion projects are in the EAP, along with one proposed new mine, as outlined below.

- **Line Creek Phase 2 Expansion** (Teck Coal Limited Line Creek Operations). An application for the Phase 2 Expansion was submitted to the Environmental Assessment Office, and permit applications were submitted to government agencies, in December 2011. This expansion, which encompasses Mount Michael and Burnt Ridge North, will extend Line Creek's production activities to the north of currently active pits. Open pit mining methods are proposed.
- **Swift Project** (Teck Coal Limited Fording River Operations). This project, which entered the EAP in 2011 and is in the pre-application stage, is located west of the Fording River and partially encompasses previous Fording River Mine pits on the Greenhills Range. Open pit mining methods are proposed.
- **Bingay Main** (Centermount Coal Ltd Mine Bingay Creek property). This proposal for a new coal mine entered the EAP near the end of the year. The proposed operation is 20 km north of Elkford in the Elk Valley. It is proposed to be mined by both open-pit and underground methods.

Other projects in the region where mine evaluation studies were carried out in 2012 included: **Marten-Wheeler** (geotechnical drilling related to design of potential open pit highwalls and baseline environmental studies by Teck Coal Limited); **Coal Creek** (baseline environmental studies by Crows Nest Pass Coal Mining Ltd); and **Moberly Silica** (detailed frac sand development engineering studies by Heemskirk Canada Limited).

## 6.4 EXPLORATION HIGHLIGHTS

Selected 2012 mineral and coal exploration projects in the Kootenay-Boundary Region are listed in Table 6.2, and their locations are shown on Figure 6.4. The selected exploration programs typically expended more than \$250 000 on work that included drilling or trenching or other mechanized ground disturbance. The information in this section was derived mainly from company reports, presentations, press releases, and websites, and discussions with exploration project staff, and was supplemented in some cases with MINFILE descriptions and Assessment Reports.



**TABLE 6.2. SELECTED EXPLORATION PROJECTS, KOOTENAY-BOUNDARY REGION, 2012**

Property	Operator	MINFILE	Commodities	Target Type	Work program	Metres of drilling (approximate in some cases)
Bingay Creek	Centremount Coal Ltd	082JSE011	coal	sedimentary	RC, TR, G, GP, GC, GD, EN, CQ	2836
Cariboo	Excalibur Resources Ltd		Au, Ag	vein	DD	1500
Coal Creek	Crowsnest Pass Coal Mining Ltd		coal	sedimentary	RC, CQ, EN	6558
Crown Mountain	Jameson Resources Limited	082GNE018	coal	sedimentary	TR, RC, CQ	5707
Eddy	PJX Resources Inc	082FSE029, 095, 116, 118	Au (Cu, Pb, Zn, Ag)	vein	DD	1077
Elkview Operations ()	Teck Coal Limited	082GNE017	coal	sedimentary	RC	14896
Findlay	MMG Limited	082KSE041, 053, 060, 075	Pb, Zn, Ag	sedex, vein	DD	1800 planned
Fording River Operations (includes Swift Project)	Teck Coal Limited	082JSE010	coal	sedimentary	RC, CQ, EN	32408
Gold Viking	Rainbow Resources Inc	082FNW193	Ag, Au,Pb, Zn	vein	DD, AB-EM	1077
Greenhills Operations (includes Cougar North Extension)	Teck Coal Limited	082JSE007	coal	sedimentary	RC, CQ	4800
Greenwood Gold (includes Overlander and P5 targets)	Grizzly Discoveries Inc	082ESE034, 147, 174, 255, 082ESW022, 210, 231	Au, Cu, Ag, Mo, Zn, Pt	vein, skarn, intrusion-related,porphyry	DD	1364
International Silver	Rainbow Resources Inc	082KNE058	Ag, Pb, Zn	vein	DD, AB-EM	773
Iron Range	Providence Resources Corp/Eagle Plains Resources Ltd	082FSE014 to 028	Au, Zn, Pb, Ag, Fe, Cu	sedex, IOCG	DD, G, P	2435
J & L	Merit Mining Corp	082M 003	Au, Ag, Pb, Zn	replacement	UG (275m), UG-DD	9725
Kena	Altair Gold Inc	082FSW237, 332, 379	Au, Cu	porphyry	DD, GC, MG, P	7429

(continued on following page)

TABLE 6.2 (CONTINUED)

Property	Operator	MINFILE	Commodities	Target Type	Work program	Metres of drilling (approximate in some cases)
Kenville	Anglo Swiss Resources Inc	082FSW086	Au, Ag, Cu	vein	DD	2776
Kokanee Graphite	Noram Ventures Inc	082FNE129	flake graphite	metamorphic	DD	1335
Line Creek Phase 2	Teck Coal Limited	082JSE001, 082GNE022	coal	sedimentary	DD, G, CQ	6911
Marten-Wheeler	Teck Coal Limited	082GNE006	coal	sedimentary	RC, GD, A, CQ, EN	13067
Ptarmigan	Silver Mountain Mines Inc	082KSE030, 036	Ag, Au, Cu, Zn	vein, manto	DD, G, GC	4050
Rozan	Emgold Mining Corporation	082FSW179	Au (Ag, Cu, Pb, Zn)	vein, skarn, porphyry	DD, GC	1500
Slocan Silver	Klondike Silver Corp	082FNW050	Ag, Pb, Zn	vein	UG, P	0
Sully	Omineca Mining and Metals Ltd		Pb, Zn, Ag	sedex	DD, GP	1234
Zinger	PJX Resources Inc	082FSE012, 120, 122	Au	vein	DD	284

A = access (trail, road construction on claims; AB-EM = airborne electromagnetics; AB-MG = airborne magnetics; AB-RD = airborne radiometrics; BU (X tonnes) = bulk sample (weight in tonnes if known); CD = condemnation drilling; CQ = coal quality testing; CT = carbonization test (coal); DD (Xm) = diamond drilling totalling X metres; EN = environmental baseline studies/monitoring, remediation work; FS = feasibility studies; G = geology, mapping etc.; GC = geochemical sampling (rock, soil, silt etc.); GD = geotechnical drilling; GP = geophysics (general); IP = induced polarization; 3D-IP; MG = magnetics; MK = marketing (primarily for industrial mineral products); MS = metallurgical studies; OB = overburden drilling; OP-BU = open pit bulk sample; P = prospecting; PD = percussion drilling; PF = pre-feasibility studies; PP = pilot plant; R = reclamation; RC (Xm) = reverse circulation drilling totalling X metres; TR = trenching; UG (Xm) = X metres of underground development; UG-BU = underground bulk sample; UT = UTEM;

### 6.4.1 East Kootenay Coalfield Projects

Teck Coal Limited undertook several programs to outline new coal resources and reserves, as either expansions or replacements of its current operations. All are in areas with potential for open-pit mining, and all represent potential sources of hard coking coal. Three other companies were also exploring for reserves of hard coking coal in the East Kootenay coalfields in 2012: Centremount Coal Ltd, Jameson Resources Limited, and Crows Nest Pass Coal Mining Ltd.

The geology of the East Kootenay coalfields is covered in Section 6.2.1.

#### 6.4.1.1 Elk Valley Coalfield

Exploration drilling at Fording River Operations was carried out at the **Henretta Phase 4** and **Swift Project** areas. The Henretta Phase 4 area is east of the current Henretta Pit footwall, on the east limb of the Alexander Creek Syncline. Exploration drilling is intended to

demonstrate mineable coal reserves down section from the current footwall limit in an area anticipated to contain coals with standard Fording River quality characteristics.

The Swift Project is west of the Fording River and adjacent to current workings and mine facilities (Fig. 6.8). The Swift Project is in the north part of the Greenhills Range (MINFILE 082JSE010), and represents both previously mined and unmined zones in the Greenhills portion of the Fording River property. Swift represents the next major potential expansion area for Fording River Operations, as a replacement for the Eagle Mountain pits, and the project is currently in the Environmental Assessment Process. It is along strike to the north of Teck's Greenhills Operations. Swift Project expansion will be based on mining multiple coal seams on both limbs of the Greenhills Syncline. Mine development will progress to the west and upward from previous open pits. The objectives of the large drilling 2012 program in the Swift Project area were to intersect ultimate pit limits in geologically complex areas, and, in the process, verify the viability of proposed pit limits, and improve resource



Figure 6.8. Exploration drilling in the Swift Project area at Fording River Operations (Teck Coal Limited). Photo by Paul Jago.

confidence levels in areas with lower drill densities. Large-diameter reverse flood drill techniques were also used on the Swift Project to collect bulk samples for coal quality testing.

At Greenhills Operations rotary drilling was carried out in the **Cougar North Extension area**, immediately north of the existing operations. Exploration was planned in conjunction with the ongoing Fording River Operations Swift Project exploration program (see above), adjacent to the north. Cougar North Extension is the proposed expansion area for the Greenhills Operations, and at full development its pits will merge with the Fording River Operations expansion. As with the Greenhills Mine as a whole, Cougar North Extension is part of the Greenhills Range and is underlain by the Greenhills Syncline. Coal seams above 7-seam are current targets for the expansion, with 7-seam and 10-seam most likely representing the greatest potential sources of coal reserves.

Teck Coal Limited's Line Creek Operations drilled the **Burnt Ridge North** area, 2 to 6 km north of currently active pits at the Line Creek Operations and roughly 8 km southeast of Elkford in the Elk Valley Coalfield. On Burnt Ridge North (MINFILE 082JSE001) the Mist Mountain Formation occurs on the west limb of the Alexander Creek Syncline. Coal-bearing strata dip moderately to steeply eastward typically forming dip slopes.

Together with Mount Michael (MINFILE 082GNE022), which is immediately to the east of Burnt Ridge and on the east limb of the Alexander Creek syncline, Burnt Ridge North is in the Environmental Assessment Process as part of the **Line Creek Phase 2 Expansion Project**. Both areas are intended to provide new reserves to replace those in Line Creek Operations' current pits. Exploration rotary drilling in 2012 was targeted at delineating mineable reserves.

The Mist Mountain Formation in the Burnt Ridge North area includes several potentially mineable coal

seams. Coal seams are predominantly medium-volatile bituminous in rank, with some high volatile-A bituminous coals near the top of the section. They are similar to seams currently being extracted at Line Creek Operations in terms of their quality characteristics.

Centremount Coal Ltd continued to evaluate the **Bingay Creek** property in 2012. The focus was on drilling for geotechnical and hydrological data, geological interpretation, and coal quality (Fig. 6.9). As noted above, the project entered the Environmental Assessment Process in 2012 for a proposed open pit and underground coal mine referred to as Bingay Main.

At Bingay Creek (MINFILE 082JSE011) the coal-bearing Mist Mountain Formation of the Jurassic-Cretaceous Kootenay Group is preserved in a tight, asymmetric syncline in the immediate footwall of the west-dipping Bourgeau thrust fault. The west limb of the Bingay Creek syncline is steeply east-dipping to overturned. Strata at Bingay Creek are contiguous with those on the west side of the Greenhills Range, and are separated from the Greenhills syncline by the Fording Mountain anticline.

In comparison to coal-bearing sections in other parts of the Elk Valley Coalfield, the section at Bingay Creek appears to be relatively rich in coal, both in terms of the number of potentially mineable seams and average seam thickness. For example, four seams are consistently

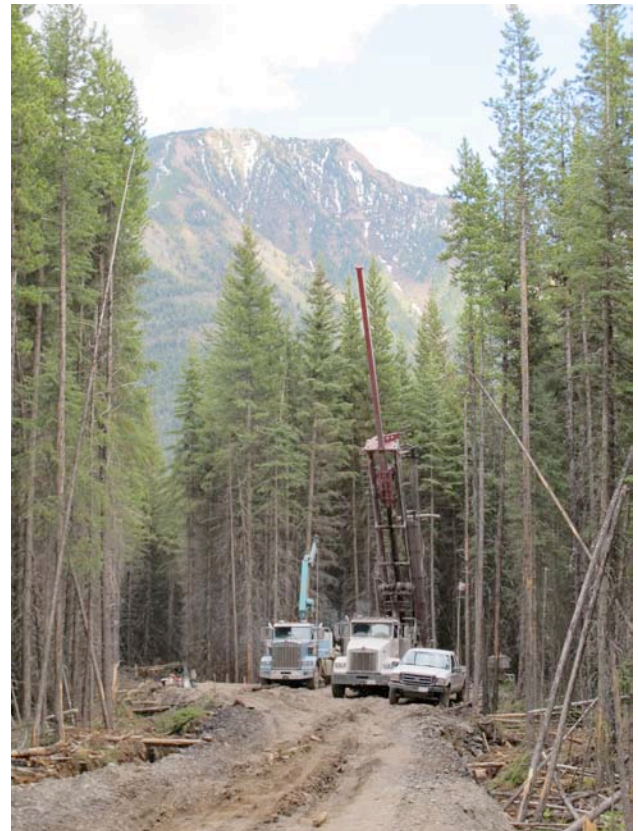


Figure 6.9. Geotechnical exploration drilling on the Bingay Creek coal property (Centremount Coal Ltd). Photo by Paul Jago.



greater than 15 m thick. Coals at Bingay Creek are known to be medium-volatile and high volatile-A bituminous in rank, based on previous exploration results.

Jameson Resources Limited carried out a drilling program on the **Crown Mountain** property (MINFILE 082GNE018), 15 km northeast of Sparwood and only 8 km east of Teck Coal Limited's Elkview Operations (Figs. 6.10 and 6.11). The Crown Mountain property is on strike with, and approximately 12 km south of, Line Creek Operations, and comprises an erosional outlier at the extreme south end of the Elk Valley Coalfield. The lower half of the Mist Mountain Formation is preserved on the main block of the property.

Drilling in 2012 was the first on the Crown Mountain property in about 30 years. The objective was to enable a resource estimate, and to collect samples for coal quality; seam characteristics are expected to be comparable to those at Line Creek and Elkview.

#### 6.4.1.2 Crowsnest Coalfield

Teck Coal drilled at several sites within the general Elkview Operations area immediately east of Sparwood. These included the Natal Phase 2, Baldy Ridge 2, and Baldy Ridge 4 areas. The Baldy Ridge 2 area includes the approved BR-2 pit.

Teck Coal continued to assess the potential of the **Marten-Wheeler** property (MINFILE 082GNE006 & 7), roughly 19 km northeast of Fernie and immediately south of Parcel 73 of the Dominion Coal Block (082GNE008). This site represents a possible expansion area for Coal Mountain Operations. It encompasses Marten and Wheeler ridges in the western part of the Crowsnest Coalfield. A major rotary drilling program was carried out in 2012, along with diamond drilling for geotechnical (mine design) and coal sampling purposes.

Crows Nest Pass Coal Mining Ltd carried out a rotary drilling program on its **Coal Creek** property, 8 km east of Fernie. The Mist Mountain Formation on the property is mainly at depth and is overlain by younger Elk Formation (Kootenay Group) and Blairmore Group strata. Coal seams at Coal Creek are on the west limb of the Fernie Basin in the Crowsnest Coalfield. Individual seams are easterly, down-dip extensions of coal seams which were accessed from their surface outcrops at the underground Coal Creek and Elk River collieries, the latter of which closed in the late 1950s. The company is targeting three seams in the uppermost part of the Mist Mountain Formation (B, 10 and 9), and is evaluating underground room-and-pillar mining potential. The 2012 drilling program was intended to build on the 2011 program by increasing drill density and further defining structure, stratigraphy, and coal quality in the initial potential development area.



Figure 6.10. Exploration drilling on the Crown Mountain coal property (Jameson Resources Limited). Photo by Geraldine FitzGerald.



Figure 6.11. Overview of the north end of the Crown Mountain coal property, looking north. Photo by Geraldine FitzGerald.

### 6.4.2 Gold Projects

#### 6.4.2.1 Boundary District

Grizzly Discoveries Ltd's extensive **Greenwood Gold** Project was active again this year. The company's holdings extend from east of Greenwood to west of Anarchist Summit, and cover an area roughly 70 km by 30 km. The project area is underlain by a range of rock units, including the Paleozoic Knob Hill and Anarchist groups, Triassic Brooklyn Formation, and Eocene Penticton Group. Intrusions of Jurassic, Cretaceous, and Eocene rocks occur throughout the area.

The project area includes many known mineral occurrences and deposit types, among them gold-quartz veins, polymetallic veins, skarns, and intrusion-related precious metals. A common theme for Grizzly Discoveries' targets is the proximity of intrusive rocks,

notably Eocene syenites. The emphasis has generally been on gold, with or without copper. High gold prices and the proximity to Kinross' Buckhorn Mine and concentrator in northern Washington favour gold exploration in the region.

Activities in 2012 included diamond drilling at the Overlander and P5 gold targets in the **Mount Attwood** area, 9 km southeast of Greenwood. Strong geophysical anomalies spatially associated with gold soil anomalies adjacent to old workings and not previously drilled were targeted in 2012. The Overlander (MINFILE 082ESE174) is known for gold-quartz veins and skarns. In the P5 target area, 2012 drilling encountered gold associated with pyrite-bearing quartz veins hosted by basalt and ultramafic units.

#### **6.4.2.2 West Kootenays**

Altair Gold Inc drilled the **Kena** property, 8 km south of Nelson. The property includes the Gold Mountain (MINFILE 082FSW379), Kena Gold (082FSW237), Kena Copper King (082FSW332), and South Gold zones. Porphyry-style gold and gold-copper mineralization is associated with both the Jurassic Elise Formation volcanic rocks (Rossland Group) and the co-magmatic Silver King porphyry intrusions. The belt comprising these zones trends northwest-southeast and is sub-parallel to and east of the Silver King Shear Zone. Gold mineralization occurs in both bulk tonnage (low-grade) and bonanza (high-grade) associations, while gold-copper mineralization occurs in bulk tonnage associations, particularly in the Kena Copper King Zone. Gold mineralization has four distinct settings: a high-grade corridor, associated with volcanics and intrusives; volcanic-intrusive contact areas; bonanza shoots; and, bulk tonnage haloes around shoots. The high-grade corridor has previously been demonstrated to extend over 5.65 km along strike.

New, updated resource estimates, including 10.85 million tonnes measured plus indicated grading 0.71 g/t Au in the Gold Mountain Zone, and 14.68 million tonnes grading 0.64 g/t in the Kena Gold Zone, were prepared this year. This represents a combined measure-plus-indicated gold resource of 549 000 contained ounces in the two zones.

The 2012 drilling program, the first for Altair Gold on the property, was designed to extend known mineralized areas down dip and along strike, and to fill in gaps between the current resource blocks. Results included 95.35m grading 1.37 g/t Au in drillhole 12GM-01 (Gold Mountain Zone).

Excalibur Resources Ltd drilled the **Cariboo** property, 8 km south of Nelson. Highest-grade mineralization on the property occurs in brecciated, quartz vein-bearing shear zones containing variable amounts of pyrite, galena and sphalerite. The Silver King Shear Zone hosts mineralization at the past-producing Silver King

Mine immediately east of the property. On the Cariboo property, two parallel mineralized trends are in metavolcanic and metasedimentary rocks of the Elise Formation (Jurassic Rossland Group). In addition, the contact between Rossland Group rocks and the Jurassic Silver King intrusion appears to host disseminated mineralization which may have bulk tonnage potential. To date, Au and Ag mineralization have been traced throughout a 200-metre trend, with the possibility of additional strike length. Drill results in 2012 included 11.1 g/t Au and 92 g/t Ag over 1.3 m (drillhole 12Car-16).

Anglo Swiss Resources Inc was active again on its **Kenville** property, roughly 6 km west of Nelson. The past-producing Kenville Mine, also known as the Granite-Poorman, operated intermittently between 1890 and 1954, with most production prior to 1912. More than 180 000 t of ore was mined, yielding over 2 t Au and 861 kg Ag, along with significant amounts of copper, lead and zinc. Production averaged more than 17 g/t Au, from a series of northeast-dipping quartz veins.

Host rocks at the Kenville (MINFILE 082FSW086) are within the Jurassic Eagle Creek plutonic complex which is intruded into, and may be the intrusive equivalent of, basalts of the Jurassic Elise Formation of the Rossland Group. Jurassic (Nelson suite) and Tertiary intrusive rocks are also common in the immediate area. The property lies on the Silver King Shear Zone.

The company is exploring for extensions of known ore-grade material and for new mineralization in the vicinity of Kenville Mine, by following up on recent vein intersections at depth to the south and southwest of the underground workings, and testing geophysical anomalies. The 2012 drill program was specifically directed at extending and infilling southerly extensions of veins and, in one case, testing a geophysical target west of the mine. Results in 2012 included 3.08 m grading 14.14 g/t Au in drillhole KE12-01. The same drillhole intersected ten separate gold-bearing veins over a core length of 400 m. Extensions of high-grade gold and silver veins, characteristic of the Kenville, have now been intersected as far as the optioned Ron property, a distance of approximately 800 m to the south.

#### **6.4.2.3 East Kootenays**

The **Zinger** property, 28 km west of Cranbrook, is part of the Kimberley Gold Trend and includes a belt of gold-in-rock anomalies covering an area 8 km by 1.5 km. In 2012, PJX Resources Inc followed up 2011 airborne geophysical surveys with a drilling program, targeting zones, including a 4 km-long magnetic trend, that correlate with gold mineralization and which could be related to silicification and alteration. Host rocks are part of the Proterozoic Purcell Supergroup, predominantly quartzites and other metasedimentary rocks of the Creston Formation, along with argillites of the Kitchener Formation and gabbro sills and dikes. The property is

adjacent to the Perry Creek fault. A newly-mapped fold structure also seems to correlate with the gold mineralization.

Known mineralization on the Zinger (MINFILE 082FSE012, 120 and 122), is predominantly vein style. Multiple linear mineralized structures and zones occur *en echelon* and are sometimes associated with shear zones. They appear as bedding-parallel quartz stockworks or quartz veins and stringers with iron carbonate, sericite, and minor sulphides including mainly pyrite (weathered to limonite near the surface), galena and chalcopyrite.

PJX Resources Inc also drilled the **Eddy** property (MINFILE 082FSE029, 095, 116, and 118), approximately 20 km southwest of Cranbrook. The property is part of the Kimberley Gold Trend and is predominantly underlain by the Aldridge and Creston formations and the Moyie sills within the Proterozoic Purcell Supergroup. The property encompasses a 20 km-long northeast-trending shear zone associated with anomalous gold in rock samples. At the surface, silicified shear zones contain narrow quartz veins, locally vuggy, that contain pyrite, partly oxidized to limonite, with rare free gold and galena. 2012 drilling targets were identified through airborne geophysics, focusing on an area where anomalies overlap an area with historical surface showings of Au, Cu, Pb, Zn and Ag.

## 6.4.3 Polymetallic Projects

### 6.4.3.1 West Kootenays

Huakan International Mining Inc carried out underground drilling at the **J&L** gold-silver-zinc-lead property, 35 km north of Revelstoke. The property lies in the Selkirk allochthon, and mineralization is hosted by the late Proterozoic to early Cambrian Hamill Group metasedimentary rocks. The polymetallic mineral zones at the J&L (MINFILE 082M 003), known as the Main Zone and the overlying Yellowjacket Zone, are stratabound, massive sulphide-bearing units interpreted as shear-hosted replacements. The Main Zone averages 2.5 m in thickness and has been exposed over 850 m along strike in underground drifting. Previous underground drilling defined the zone over a 1.2 km strike length, while on surface it has been traced for 1.6 km. It has been traced down-dip for 800 m.

Underground drifting over the winter of 2011/2012 was followed by a drilling campaign (Phase 2) totalling 9725 m. Results included 9.41 g/t Au, 101 g/t Ag, 2.17% Pb and 4.31% Zn over 8.48 m in the Main Zone (drillhole 12-10). Information from the Phase 2 drilling campaign was incorporated in a new NI 43-101 resource estimate. The estimate includes 3.953 Mt measured-plus-indicated resources grading 5.68 g/t Au, 56.5 g/t Ag, 1.94% Pb and 3.56% Zn in the Main Zone. This represents 722 000

ounces of gold in the measured and indicated categories. The Yellowjacket Zone, which was included in a resource estimation for the first time, contains 1.003 Mt at 64.1 g/t Ag, 2.77% Pb, 9.08% Zn and 0.21 g/t Au in the indicated category.

Emgold Mining Corporation carried out a diamond drilling program on the **Rozan** property, 11 km south of Nelson. The Rozan claims straddle a northwest-southeast trending package of sheared rocks parallel and in close proximity to the Silver King Shear Zone. Host rocks belong to the Jurassic Elise and Archibald formations (Rossland Group), and Jurassic Nelson intrusions. Known mineralization on the property is generally polymetallic (Au, Ag, Cu, Pb, and Zn), but the current exploration focus is on gold, both high-grade veins and bulk-mineable, disseminated zones. 2012 drill sites were selected to test target areas defined in historic and recent exploration on the main part of property. These target areas include the Main Vein at the Rozan (also known as the Golden Eagle, MINFILE 082FSW179), which was mined between 1928 and 1972, and the so-called sheeted vein zone, 700m to the east. Target mineralization may be similar to intrusion-hosted quartz vein systems. Other styles of mineralization on the property include polymetallic stockwork veins and skarns, and porphyry and/or shear-hosted systems (see Assessment Report 32592).

Rainbow Resources undertook an initial drilling program on the **Gold Viking** Ag-Au-Pb-Zn property, 2 km northeast of Slocan City. The property is part of Rainbow Resources' large Big Strike Project, which comprises several properties with varying styles of mineralization in different parts of the West Kootenays (see also International Silver, below). The Gold Viking past producer (MINFILE 082FNW193) is hosted by granitic rocks near the western margin of the Jurassic Nelson batholith. Mineralization, comprising galena, sphalerite, pyrite, and chalcopyrite, is associated with quartz veins in north and northeasterly-trending shear zones. Gold is believed to be associated with pyrite. Shipments from 1932 to 1936 totalled 15 t, yielding 4790 g Ag, 373 g Au, and 14 kg Pb.

A pyrite-rich stockwork vein system and breccia zones within altered quartz monzonite were observed in 2012 drill core. Preliminary results included 45 g/t Ag and 0.6 g/t Au over 4.6 m (drillhole GV-12-02).

### 6.4.3.2 East Kootenays

Providence Capital Corp and Eagle Plains Resources Ltd continued diamond drilling on the **Iron Range** property, about 15 km northeast of Creston. There are two settings for mineralization at the Iron Range. One group of occurrences (MINFILE 082FSE014 to 028) is associated with iron oxide breccias along the Iron Range fault. These have possible affinities with iron oxide-copper-gold (IOCG) mineralization. The second style is



sedimentary exhalative (sedex) mineralization associated with the contact between the lower and middle members of the Aldridge Formation (known as the Sullivan horizon) in the Proterozoic Purcell Supergroup. This latter style is analogous to the Sullivan Mine ore body at Kimberley.

Most recent exploration has been focused on a potential sedex target near the south end of the Iron Range. Results indicate significant levels of gold associated with massive sulphides containing Ag, Pb and Zn at and near the Sullivan horizon, possibly formed in a hydrothermal vent system. This new discovery is termed the Talon Zone, and drilling in 2012 was partly aimed at testing the strike extent of the zone and a series of coincident gravity and geochemical anomalies. The program extended the Talon Zone 120 m along strike to the southwest.

Silver Mountain Mines Inc again drilled the **Ptarmigan** polymetallic property, 27 km west of Invermere in the Purcell Mountains. The property includes the past-producing Ptarmigan (MINFILE 082KSE030) and Iron Cap (082KSE036) occurrences. Mineralization occurs in polymetallic veins or in massive sulphide replacements in carbonates (mantos), and generally consists of pyrite, galena, sphalerite, and tetrahedrite. The Ptarmigan Mine itself consisted of a series of adits driven along the fault contact between Windermere Supergroup strata to the east and the upper Purcell Supergroup strata to the west. Mineralization is stratigraphically below the Windermere unconformity, in strata of the Purcell Supergroup. Selective mining of the Ptarmigan yielded grades of over 4000 g/t Ag, 5.4 g/t Au, 0.6% Cu and 0.5% Zn.

The 2012 drilling campaign was focused on the Ptarmigan Mine and the Upper Ptarmigan and East Ptarmigan zones. The program was designed to define known mineralized zones, and it also identified new silver-bearing veins and semi-massive to massive manto-style mineralization. Drilling results in 2012 included 6.8 m grading 0.52 g/t Au and 452 g/t Ag (drillhole PT12-64).

## 6.4.4 Base Metals Projects

### 6.4.4.1 West Kootenays

Rainbow Resources Inc carried out a drilling program on the **International Silver** property, on the east side of Duncan Lake, 65 km north of Kaslo. The property is part of Rainbow Resources' large Big Strike Project, which comprises several properties with varying styles of mineralization in different parts of the West Kootenays (see also Gold Viking, above). The target was the International Ag-Pb-Zn vein (MINFILE 082KNE058), which had not been previously drilled. It is a quartz vein

that contains irregular massive bodies of galena, pyrite, and sphalerite. Host rocks are carbonaceous and micaceous schists of the Proterozoic Horsethief Creek Group. Previous exploration suggested that the mineralization may be continuous over a distance of up to 1.2 km, and geophysical evidence suggests that the mineralized zone may be more extensive. Drilling in 2012 was concentrated in the Cabin Zone, approximately 1 km south of the initial discovery area. Mineralized quartz veining, ranging in drill width from 1.5 to 6 m, was intersected in all 15 holes.

Klondike Silver Corp's **Slocan Silver** Project, east of New Denver, is in a rich historic silver-lead-zinc mining area. Klondike's extensive holdings are divided into various areas, each of which encompasses past producers of vein-style mineralization. These include the Sandon, Hewitt, Silverton Creek, Cody Creek, Payne, and Jackson Basin camps. Mineral occurrences in the Slocan are hosted by sheared and brecciated argillites and slates of the Triassic Slocan Group intruded by granodiorite and quartz monzonite dikes.

There was only minor surface exploration related to the Slocan Silver Project in 2012. The main focus of activity was underground, specifically rehabilitation on the 4000 level in the Silvana past producer (MINFILE 082FNW050) and the location and recovery of remnant ore in the Silvana (4625 level) and Hinckley past producer (MINFILE 082FNW013). Total ore recovery in 2012 was approximately 6000 t. The company's Silvana mill at Sandon, a 100 t/day concentrator, currently operates at an average rate of 40 t/day. The company has an arrangement for a smelter to accept concentrates. The overall goal of the company is to locate sufficient ore to operate the mill at maximum capacity.

### 6.4.4.2 East Kootenays

MMG Limited carried out a helicopter-supported drill program on the Findlay property (MINFILE 082KSE041, 053, 060, 075), 30 km southwest of Canal Flats and 40 km northwest of Kimberley. The property is underlain by the Proterozoic Purcell Supergroup, including the Aldridge Formation, and Cretaceous intrusions. Targets include the Sullivan horizon in the Aldridge Formation, which corresponds with the contact between the lower and middle members of the formation, and hosts the Sullivan Mine Pb-Zn-Ag ore body at Kimberley. Moreover, typical indicators of Sullivan-style (sedex) mineralization occur throughout the lower to upper Aldridge, indicating potential for Sullivan-style mineralization at multiple stratigraphic levels. These indicators, which are related to hydrothermal venting, include tourmalinized horizons, sections of fragmental sediments, anomalous Pb, Zn, and indicator element geochemistry, and known base metal occurrences, including both stratabound and vein style. This evidence is consistent with the interpretation that this part of the

Purcell Basin may be the northern extension of the Sullivan-North Star structural corridor that includes the Sullivan ore body.

Omineca Mining and Metals Ltd drilled one diamond drillhole on the **Sully** property, located at the base of the Hughes Range on the east side of the Rocky Mountain Trench, 22km northeast of Cranbrook (Fig. 6.12). The objective of the drilling program was to test a significant sub-surface gravity anomaly. This anomaly, when considered in conjunction with other geophysical and geological evidence, suggests potential for a sulphide-bearing mineral occurrence at the same stratigraphic horizon in the Aldridge Formation (Proterozoic Purcell Supergroup) that hosts the Sullivan Mine sedex ore body at Kimberley. The drillhole was collared in the Aldridge Formation and penetrated both Aldridge and underlying Fort Steele Formation strata in the steep limb of a major overturned fold. Significant drill deviation caused the hole to miss the targeted area. However, subsequent to the drilling program the company undertook a reconnaissance surface and down-hole TDEM geophysical survey, followed by more substantial surface geophysical surveys, to further test the gravity anomaly. Omineca subsequently dropped its option, but Gravitas Metals Corp, the optioner, intends to continue drilling next year.

## 6.4.5 Industrial Minerals Projects

### 6.4.5.1 West Kootenays

Noram Ventures Inc drilled the **Kokanee** flake graphite property 35 km northeast of Nelson, near Crawford Bay on the east side of Kootenay Lake. The property has been explored for base metals since the early 1900s, after the discovery of large massive sulphide-

bearing boulders (MINFILE 082FNE129). This year's program represents the first assessment for graphite potential. The graphite is hosted by calcsilicates of the Cambrian to Devonian Index Formation (Lardeau Group). The property is also underlain by older Cambrian rocks and Cretaceous granitic intrusions. The 2012 drilling was conducted in a portion of the main zone, where sampling has confirmed presence of large-flake graphite over an area about 2 km in strike length and 200 to 300m in width, coincident with an EM anomaly.

## ACKNOWLEDGMENTS

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Figure 6.12. Diamond drilling on the Sully property (Omineca Mining and Metals Ltd).

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