



Ministry of Energy, Mines  
and Petroleum Resources  
Mineral Resources Division  
Hon. Anne Edwards, Minister

# British Columbia Mining, Exploration and Development 1993 Highlights

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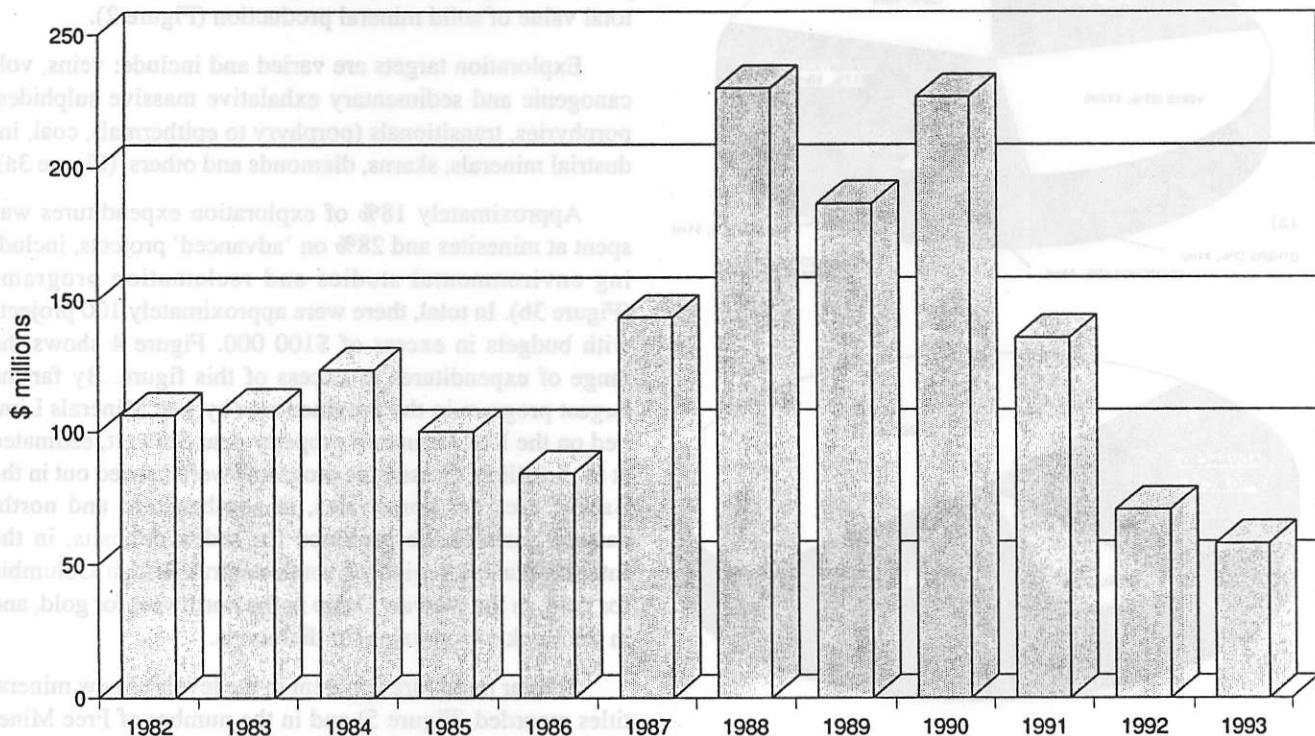
### INTRODUCTION

The intense global competition for high-risk exploration dollars has been very noticeable in British Columbia. The exploration industry has experienced a year of decreased expenditures, however, several companies and individuals continued to conduct small to medium-sized programs, primarily in areas having a good database, known resources in the ground, and higher probability for development and production. Targets included many of the classic mineral deposit types for which British Columbia is well known. Several relatively recent discoveries such as Eskay Creek, Red Mountain, and Huckleberry (East zone) have increased interest. The estimate for the number of claim units recorded in 1993 is down about 17% from 1992, but several restaked claims covered old properties with sufficient work completed on them to indicate potential. Custom milling facilities at Premier, Equity Silver and Goldstream and a sharp rally in the price of gold beginning in April 1993 may enable small, high-grade, gold operations

to start up, both in British Columbia and in Alaska. A number of advanced projects have entered the Mine Development Assessment Process, with many in the pre-feasibility stage. Industrial minerals are receiving increasing interest.

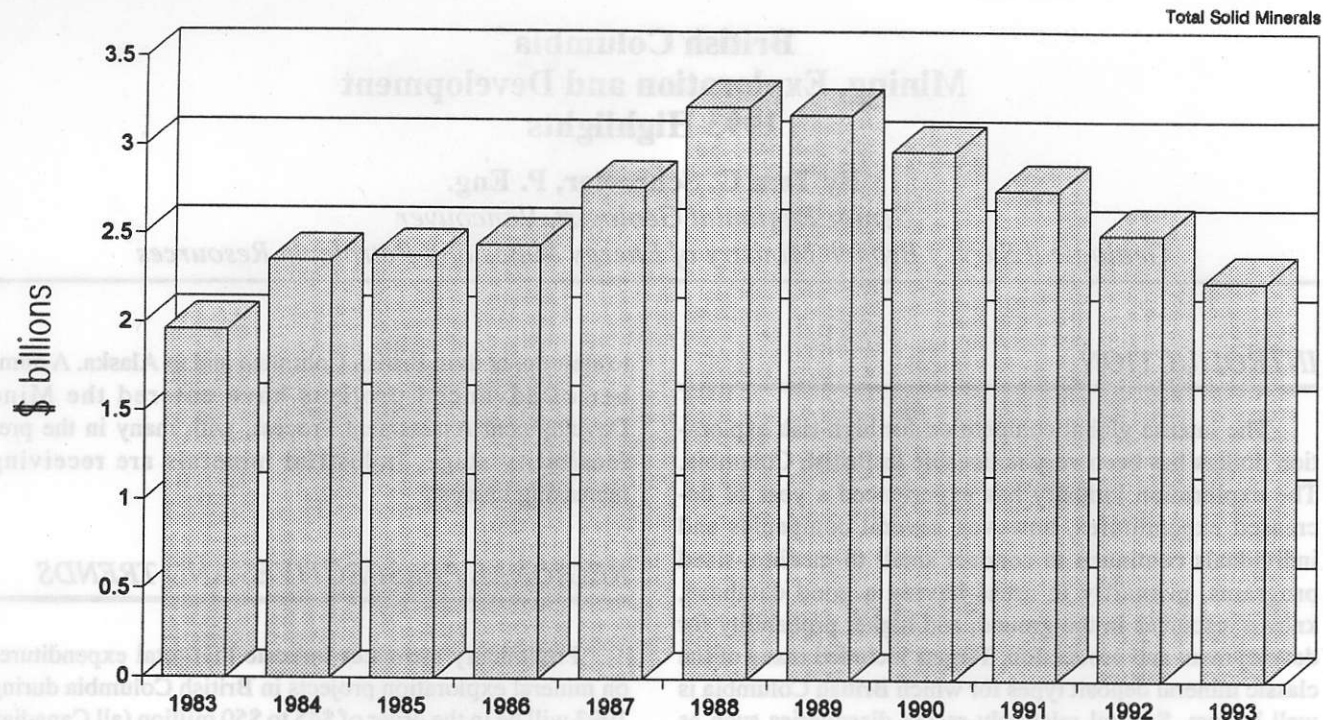
### REGIONAL PERSPECTIVES AND TRENDS

Preliminary estimates indicate that total expenditures on mineral exploration projects in British Columbia during 1993 will be in the order of \$45 to \$50 million (all Canadian \$ unless otherwise stated). It is estimated that greater than 50% of this figure will be spent in the northwest part of the province. This figure is compiled from estimates made by Ministry Geologists on a project-by-project basis throughout the province and is an estimate of the actual total dollars spent on the ground. The official Mineral Statistics Survey forecasts a total of \$58 million. This figure includes non property costs.



Source: MEMPR, Land Management and Policy Branch

Figure 1. Mineral exploration expenditures in B.C. 1983-1993.



Source: MEMPR, Land Management and Policy Branch

Figure 2. Mineral production in B.C. 1983 to 1993.

Figure 1 illustrates the wide fluctuation of exploration expenditures over the past decade. The peak year 1988, with expenditures of \$208 million, coincided with the height of flow-through funding. The past five years have shown a steady decline. For the same ten-year period, the pattern of exploration spending is similar to changes in the total value of solid mineral production (Figure 2).

Exploration targets are varied and include: veins, volcanogenic and sedimentary exhalative massive sulphides, porphyries, transitionals (porphyry to epithermal), coal, industrial minerals, skarns, diamonds and others (Figure 3a).

Approximately 18% of exploration expenditures was spent at minesites and 28% on 'advanced' projects, including environmental studies and reclamation programs (Figure 3b). In total, there were approximately 100 projects with budgets in excess of \$100 000. Figure 4 shows the range of expenditures in excess of this figure. By far the largest program in the province was by Lac Minerals Limited on the Red Mountain property near Stewart, estimated at \$7.5 million. Grassroots programs were carried out in the Babine area for porphyries, in southeastern and northeastern parts of the province for sedex deposits, in the Interior Plateau region of south-central British Columbia for gold, in the Stewart Camp in the northwest for gold, and in the Rocky Mountains for diamonds.

Similar trends are apparent in the levels of new mineral titles recorded (Figure 5) and in the number of Free Miner Certificates issued to explorationists operating in the province (Figure 6). Many of the claims staked are over

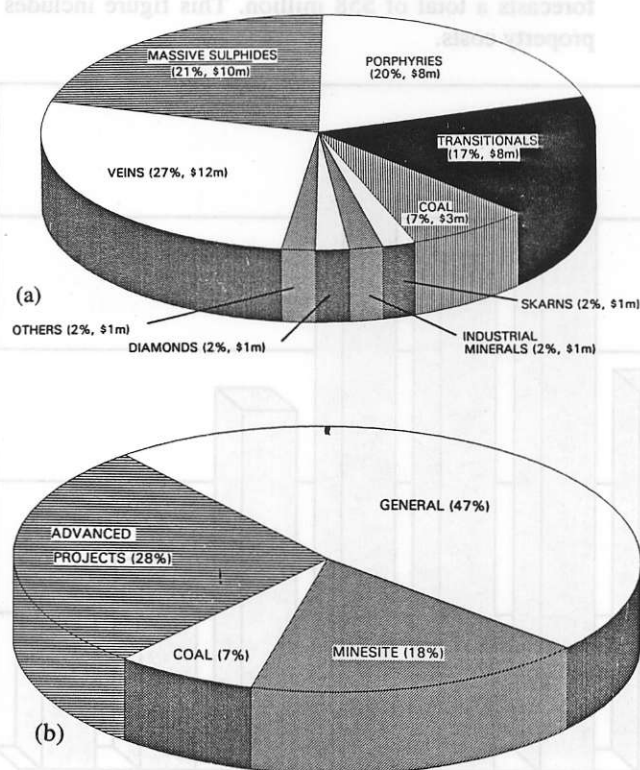


Figure 3. Exploration targets - 1993 (a) by deposit type (% and expenditures); (b) by level or category of program.

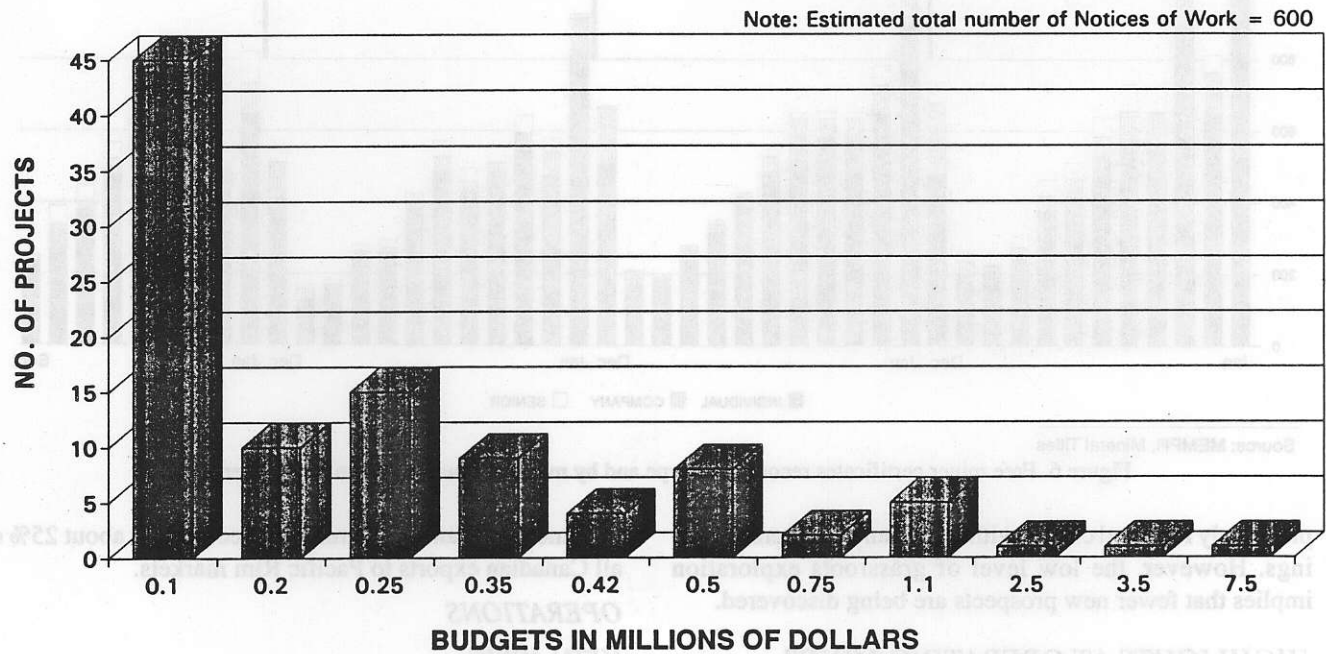
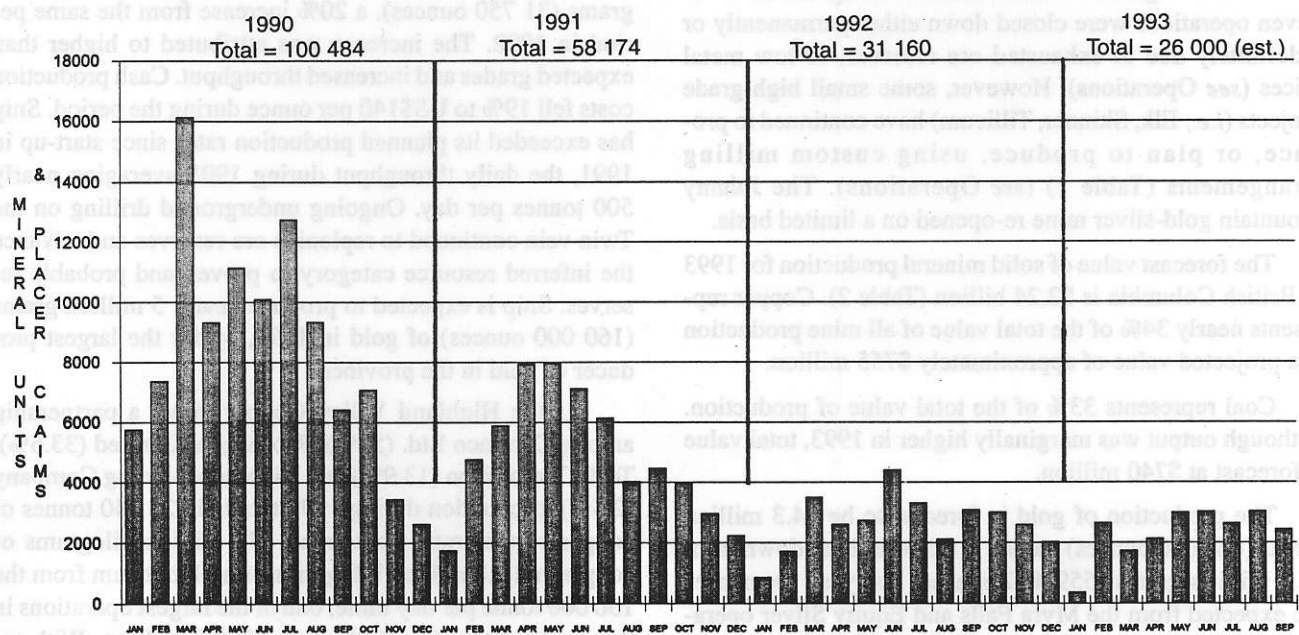
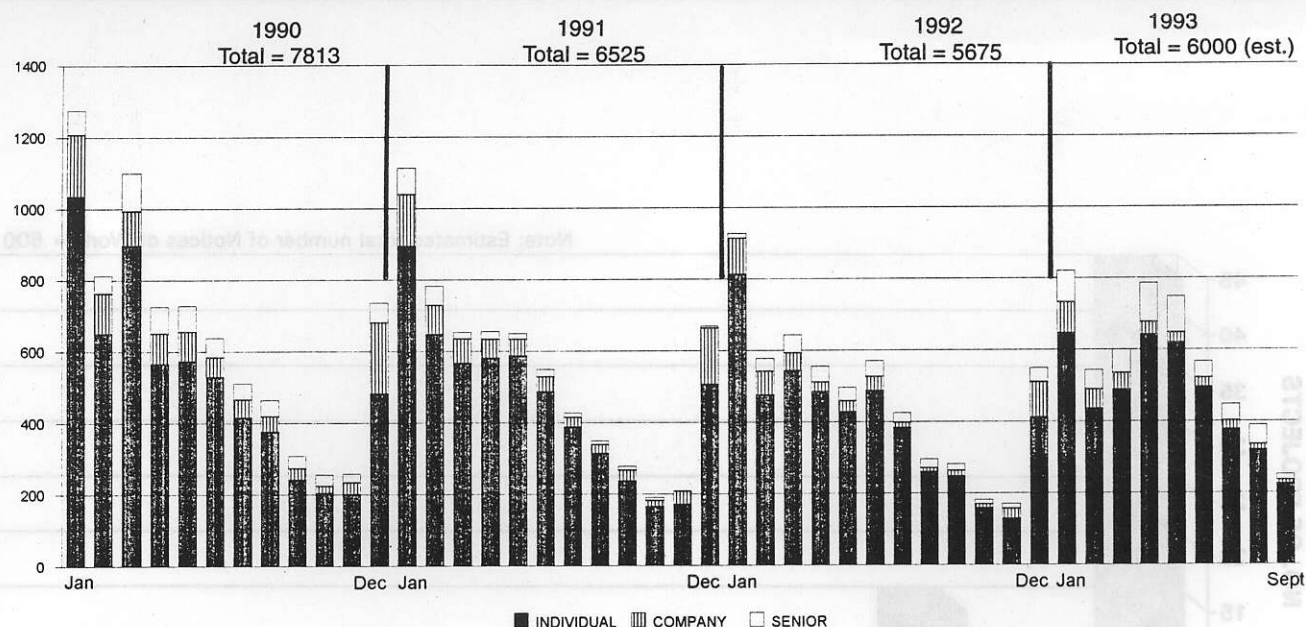


Figure 4. Estimated number of major projects (&gt;\$100,000).



Source: MEMPR, Mineral Titles Branch

Figure 5. All mineral tenure recorded by month; January 1990 to September 1993.



Source: MEMPR, Mineral Titles

Figure 6. Free miner certificates recorded by type and by month; January 1990 to September 1993.

previously forfeited claims with documented mineral showings. However, the low level of grassroots exploration implies that fewer new prospects are being discovered.

## HIGHLIGHTS AT OPERATING MINES

### PRODUCTION LEVELS

The locations of operating mines in British Columbia are shown in Figure 7. No new mines were opened in 1993. Seven operations were closed down either permanently or indefinitely due to exhausted ore reserves, or low metal prices (*see Operations*). However, some small high-grade projects (*i.e.*, Elk, Skinner, Tillicum) have continued to produce, or plan to produce, using custom milling arrangements (Table 1) (*see Operations*). The Johnny Mountain gold-silver mine re-opened on a limited basis.

The forecast value of solid mineral production for 1993 in British Columbia is \$2.24 billion (Table 2). Copper represents nearly 34% of the total value of all mine production at a projected value of approximately \$755 million.

Coal represents 33% of the total value of production. Although output was marginally higher in 1993, total value is forecast at \$740 million.

The production of gold is forecast to be 14.3 million grams (460 000 ounces) valued at \$204 million, down from 17.4 million grams (559 400 ounces) last year. Decreases are expected from the Myra Falls and Equity Silver operations. Silver output is forecast at 145 million grams (321 million ounces) valued at \$25 million, down slightly due to reduced production at the Equity Silver and Myra Falls operations. Zinc production in 1993 is forecast to be 76 million kilograms worth \$96 million; lead output is forecast to be 39 million kilograms valued at \$20 million. British

Columbia coal and solid minerals account for about 25% of all Canadian exports to Pacific Rim markets.

## OPERATIONS

### METAL MINES

The Snip gold mine, owned and operated by Cominco Ltd. (60%) and Prime Resources Ltd. (40%), produced 4.77 million grams (153 400 ounces) of gold in 1992. During the first six months of 1993 the mine produced 0.99 million grams (31 750 ounces), a 20% increase from the same period in 1992. The increase was attributed to higher than expected grades and increased throughput. Cash production costs fell 19% to US\$140 per ounce during the period. Snip has exceeded its planned production rates since start-up in 1991, the daily throughput during 1993 averaging nearly 500 tonnes per day. Ongoing underground drilling on the Twin vein continued to replenish ore reserves and advance the inferred resource category to proven and probable reserves. Snip is expected to produce nearly 5 million grams (160 000 ounces) of gold in 1993, by far the largest producer of gold in the province.

At the Highland Valley Copper mine, a partnership among Cominco Ltd. (50%), Rio Algom Limited (33.6%), Teck Corporation (13.9%) and Highmont Mining Company (2.5%), production during 1992 totalled 422 340 tonnes of copper concentrates containing 171 million kilograms of copper and 1.8 million kilograms of molybdenum from the 130 000 tonne per day mine, one of the largest operations in the world. Sales for 1992 were \$373.9 million. With reserves of 632.9 million tonnes averaging 0.414% copper and 0.0068% molybdenum, the mine life is estimated to be about 15 more years.

The Island Copper mine produced 45.1 million kilograms of copper, 378 232 kilograms of molybdenum, 1.6

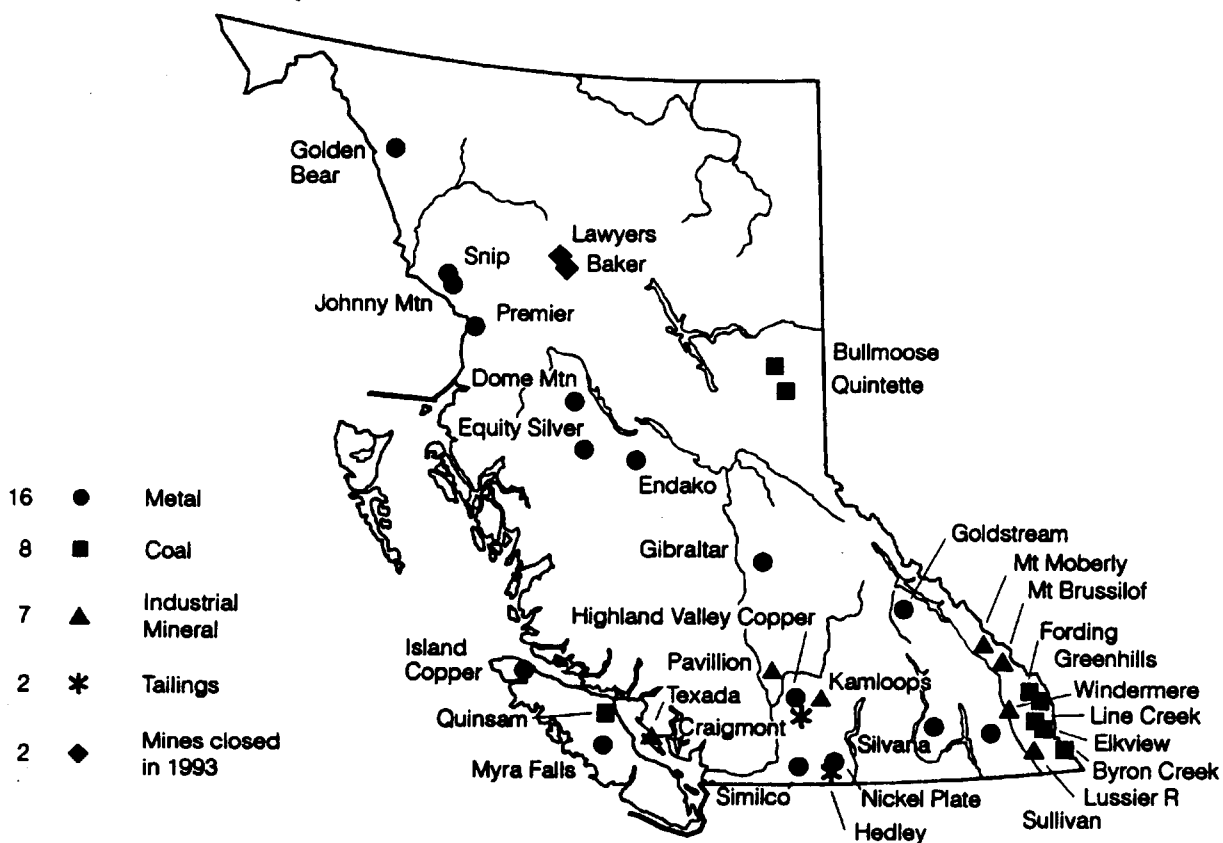


Figure 7. Operating mines in B.C. - 1993.

TABLE 1  
CUSTOM MILLING PROJECTS

Mill Smelter	Project Name (Potential)	Commodity	Tonnes Milled (Planned)	Metals Recovered (Planned)
Home/Helena	Elk	Au	(4080)	(373.2 kg Au)
Premier	Skinner	Au	172	11.4 kg Au, 4.9 kg Ag
Premier	(Debbie)	Au		
Goldstream	Tillicum	Au	(5400)	(129.6 kg Au)
Premier	Silver Butte	Au		
Premier	(Greens Creek)	Au,Cu,Ag,Pb,Zn		
Premier	(Johnson River)	Au,Cu,Ag,Pb,Zn		
?	(Brett)	Au,Ag		
Island Copper	(Red Dog)	Cu,Au,Mo		
Island Copper	(Hushamu)	Cu,Au,Mo		
Premier ?	(Red Mtn.)	Au,Ag		
Equity Silver	Dome Mtn.	Au,Ag		
Standard	Iron Colt	Au		

TABLE 2  
1993 ESTIMATED VALUE OF MINERAL PRODUCTION IN B.C.

Commodity	Quantity (millions)	\$ Value (millions)	Per cent of Total Value
Copper	308 kg	755	34
Gold	14.3 g	204	9
Zinc	76 kg	96	4
Lead	39 kg	20	1
Molybdenum	9.4 kg	56	2
Silver	145 g	25	1
Other		6	
<b>Total Metals</b>		<b>1161</b>	<b>52</b>
Structural Materials		300	13
Industrial Minerals		40	2
Metallurgical Coal	16.45 t	695	31
Thermal Coal	1.98 t	45	2
<b>Total Solid Minerals</b>		<b>2241</b>	<b>100</b>

Source: MEMPR, Land Management and Policy Branch

million grams (50 613 ounces) of gold and 14.3 million grams (459 037 ounces) of silver in 1992. Daily throughput averaged 48 725 tonnes at a head grade of 0.35% copper. The mine, in production since 1971, is expected to cease operations in late 1996. In 1993 BHP Minerals Canada introduced a proposal to convert the mined-out open pit into a garbage disposal site for such cities as Vancouver and Victoria, British Columbia and Seattle-Tacoma, Washington. BHP continued to conduct exploration in the general area, and other nearby copper properties (e.g., Hushamu and Red Dog) are being re-examined by other companies with a view to using the existing infrastructure at the Island Copper mine.

Production at the Westmin Resources Limited Myra Falls mine was affected by a labour dispute (since April 24) and low copper and zinc prices. Prior to the dispute, the Lynx mine was to be put on a care and maintenance basis. Total proven and geological reserves as of January 1, 1993 were 12 516 000 tonnes grading 2.1 grams per tonne gold, 45.6 grams per tonne silver, 1.9% copper, 0.5% lead and 6.3% zinc. A further 2 706 000 tonnes were identified in the possible geological reserves category. Delineation drilling on the Battle/Gap area has yielded several significant intersections, particularly in the area northwest of the Gap zone and north of the North Down Drop fault. The exploration potential of the northern part of the property is now considerably enhanced. Exploration is continuing at the Battle zone in preparation for mining. Drilling continues to delineate the zinc-rich Top zone and the gold-rich South Trough zone, and confirms the high grade of the mineralization.

Mining of the Battle zone is scheduled to begin in early 1994.

A new collective agreement should pave the way for Gibraltar to proceed with a \$35 million expansion plan. The plan calls for increasing the milling capacity to 51 700 tonnes from 34 500 tonnes per day and cash costs to be lowered by an estimated US 7-8¢ per pound of copper. The company received additional funding through a share purchase by Placer Dome Inc. reducing its interest in Gibraltar to about 44% from 68.1%. During the summer, new short term heap-leach pads were built to treat oxidized ore. The molybdenum circuit was closed in December, 1992 and did not operate in 1993. Mining and milling operations were temporarily suspended from July 23 to August 25 to allow for \$ 4.9 million in expenditures on development of Stage 3 of the Gibraltar East Pit and for general maintenance. The company proceeded with solvent extraction electrowinning. In 1996, which would be the first full year of expanded operation, production of copper in concentrates is expected to show an increase of 49% over 1992. Gibraltar's ore reserves are estimated at 147 478 200 tonnes grading 0.301% copper and 0.0084% molybdenum. These do not include the North Gib deposit which has a higher grade of copper estimated to be 0.4%.

At the Equity Silver mine, formerly an open pit operation, mining was carried out underground on the North zone at a rate of 1180 tonnes per day. Proven and probable ore reserves at the end of 1992 were estimated at 226 610 tonnes grading 147.8 grams per tonne silver, 4.22 grams per tonne gold, and 0.46% copper, based on a 300 grams silver-

equivalent grade. Recovery of gold is estimated at 44%. Equity has also identified a small open-pit reserve at the bottom of the Waterline pit which, when combined with underground reserves, should provide mill feed through the first two months of 1994. Ongoing reclamation work, particularly the reclaiming of waste dumps, continues to provide better than expected results and at lower than expected costs. The company is also engaged in discussions with the operators of the Eskay Creek gold project regarding the use of the Equity facilities for processing Eskay ore.

In 1992 the Homestake Canada Ltd. Nickel Plate mine produced 2.63 million grams (84 673 ounces) of gold and 0.75 million grams (24 164 ounces) of silver from 1 233 800 tonnes of ore at a milling rate of 3370 tonnes per day. Reserves were estimated at 5 650 610 tonnes grading 2.57 grams per tonne gold. Following a review of the results of a diamond drilling program, Homestake proceeded with expansion of the main pit which is expected to extend the mine's life to 1997 with annual production of gold estimated at 2.5 million grams (80 000 ounces).

Cominco Ltd. production at the Sullivan mine in 1992 was nearly 38 million grams (1 220 000 ounces) of silver, 51.8 kilograms of lead and 98.5 million kilograms of zinc from about 1.6 million tonnes of ore at a daily milling rate of 8980 tonnes.

Gold production from the Golden Bear mine in 1992 was 1.8 million grams (58 224 ounces) at a cash cost of \$352 per ounce. In April 1993 after completing a negative feasibility study on an expansion of the open pit, Homestake Mining Ltd. relinquished its interest in the mine to Wheaton River Minerals Limited by selling its 85% interest in North American Metals Ltd. Stockpiled ore from 1992 operations was milled during 1993 and Wheaton River Minerals is developing the Bear Main orebody with sub-levels at 10-metre intervals and long-hole stoping scheduled to begin in October. Based on current reserves in the Bear Main zone, estimated at about 165 000 tonnes grading between 20 and 23 grams per tonne gold, and a milling rate of 400 tonnes per day, the mill has sufficient feed to last into late 1994. The company expected to meet its production target of 1.87 million grams (60 000 ounces) per year at an estimated cash operating cost of about US\$260 per ounce. Other reserve areas include the Bear South and Florence Bowi zones. In September a \$350 000 exploration program was commenced. Trenching and limited follow-up diamond drilling has located two 'new' zones: the Kodiak, along strike and about two kilometres north of the mine site, and the Grizzly, below the Bear Main zone. A two-phase winter drilling program is scheduled to further test these zones.

During 1992 the Similco Mines Ltd. Similco operation produced 26.6 million kilograms of copper, 499 kilograms (16 037 ounces) of gold and 9749 kilograms (313 442 ounces) of silver from 6 139 584 tonnes of ore at a daily

milling rate of 20 200 tonnes. Reserves at January 1, 1993 stood at approximately 20 million tonnes grading 0.361% copper with additional values in gold. Production over the winter was significantly less than expected due to severe weather which interrupted mining and ore delivery. Falling copper prices also contributed to losses. During 1993 Similco conducted a moderate exploration program designed to locate new low-cost reserves on its property.

During 1993 the Westmin Resources Limited Premier gold mine ran at 25% capacity on underground ore and some remaining stockpiled open-pit ore. In 1992, 1107 kilograms (35 597 ounces) of gold and 8723 kilograms (280 463 ounces) of silver were produced from 389 130 tonnes of ore at a daily milling rate of about 2200 tonnes. Underground mining at a rate of 700 tonnes per day continued in good grade ore and operated profitably. Proven and probable reserves as of January 1, 1993 were estimated at 107 250 tonnes grading 8.91 grams per tonne gold and 30.0 grams per tonne silver. The company continues to examine the option of custom milling ore from various sources including: Sulphurets (Brucejack); Chichagof, Greas Creek and Johnston River Alaska; Skinner, Red Mountain and Westmin's own Debbie property. An exploration program tested other showings on the property.

During 1992 the Goldstream mine, operated on a 50-50 basis by Goldnev Resources Inc. and Bethlehem Resources Corporation, produced 16.2 million kilograms of copper and 1.6 million kilograms of zinc from 430 825 tonnes of ore at a daily milling rate of 1150 tonnes. Mining reserves at April 1, 1993 were 1.436 million tonnes grading 4.48% copper, 3.03% zinc and 8.2 grams per tonne silver. This represents a 26% increase from the November 1992 calculation. Underground mining operations were suspended in May to allow time to revise mining plans to reduce costs in the light of decreasing copper prices, to decrease the environmental liability associated with the surface stockpiles by milling them, and to allow for a smooth transition between underground mining contractors. Underground mining operations resumed in June using the revised mining plan. Bethlehem carried out a two-phase exploration program including diamond drilling to test targets based on geophysical interpretation of a previously flown airborne survey and recent discovery of mineralized float and outcrop in the area south of the mine. Bethlehem, in a joint venture agreement with Columbia Gold Mines Ltd., plans to custom mill approximately 5400 tonnes of ore grading about 24 grams per tonne gold from the Tillicum property, at the Goldstream mill. Virtually all of the Tillicum gold blended into the Goldstream concentrate will constitute a credit which will accrue to the joint venture.

In the last half of 1993, International Skyline Gold Corporation completed rehabilitation and recommissioning of the Johnny Mountain gold mine. The concentrator was expected to treat 18 140 tonnes of ore containing an estimated

minimum 17.5 grams per tonne gold at a daily milling rate of 320 tonnes prior to shut down for the winter. The projected output was about 311 000 grams (10 000 ounces) of gold, 54 400 kilograms of copper and 466 550 grams (15 000 ounces) of silver, at an estimated cash operating cost of US\$233 per ounce gold. Underground and surface exploration and development of reserves were concentrated on the Zephrin vein in the Stonehouse gold deposit and on recovery of remnant blocks of the 16 vein. The company went into the site this spring with 23 580 tonnes of ore identified. In addition, Skyline completed an induced polarization survey on the Bronson Creek (Red Bluff) porphyry copper-gold prospect located near the mine and follow-up diamond drilling was carried out.

At the Endako molybdenum mine, Placer Dome Inc. produced 7 million kilograms of molybdenum in 1992 from 9 675 500 tonnes of ore at a daily milling feed of 27 500 tonnes. Reserves as of January 1, 1993 were 120 338 000 tonnes grading 0.0816% molybdenum.

In May 1993, the Dome Mountain gold mine was temporarily shut down to comply with the B.C. Ministry of Energy, Mines and Petroleum Resources' safety regulations, and because of continuing legal negotiations between Habsburg Resources Inc. and Timmins Nickel Inc. During 1992 the operation produced an estimated 275 260 grams (8850 ounces) of gold from 27 685 tonnes of ore via a custom milling agreement with Equity Silver Mines Ltd. Reserves at January 1, 1993 were estimated at 253 960 tonnes grading 11.3 grams per tonne gold. In August 1993, Habsburg reached agreement with Timmins Nickel to cease all legal action and restructure the Dome Mountain joint venture, giving Habsburg an 80% interest in the mine. Habsburg will be the operator and work began to develop a capital budget and new mine plan to enable resumption of production at a rate of 225 tonnes per day for an estimated four-year mine life.

During 1992 metal production at the Tremanco Resources Ltd. Silvana mine totalled nearly 8.4 million grams (269 000 ounces) of silver, 1.03 million kilograms of lead and 1 million kilograms of zinc from 16 326 tonnes of ore. Reserves at the Silvana and Hinckley mines as of July 31, 1992 were 27 480 tonnes grading 289 grams per tonne silver, 3.47% lead and 4.74% zinc.

#### TAILINGS

During 1993 Canadarado Mines Ltd. received a Mine Development Certificate for its Hedley tailings project for the reworking of an estimated 50 000 tonnes of old tailings from the historic Hedley (Nickel) gold mine, over a two-year period.

Craigmont Mines Ltd. and M-7 Industries Ltd. continued to recover magnetite from the stockpile remaining from past operations at the Craigmont mine. The product is shipped primarily to the coal industry in northeast and

southeast British Columbia. Craigmont has received a Mine Development Certificate to treat the old tailings with the goal of processing 30 000 tonnes of magnetite per year.

#### COAL MINES

Coal production increased significantly from 1992 levels. Coal quality attributes, such as low sulphur content and low ash basicity, make British Columbia coal attractive in global markets and help maintain the province's position among world suppliers over the long term.

Increased confidence and interest in coal is exemplified by the large exploration programs carried out at three operating mines, as well as the renewed activities at the Telkwa and Isolum Creek thermal coalfields.

In the Peace River coalfields, coal companies made productivity gains as they continue to operate as dedicated suppliers to the Japanese steel industry. The expiration of the first 15-year contract period in 1998 will undoubtedly see prices renegotiated. The Bullmoose mine of Teck Corporation (60.9%), Rio Algom Ltd. (29.1%) and Nissho Iwai Ltd. (10%) recently negotiated a new 4-year price agreement with the Japanese steel mills to supply metallurgical coal. Bullmoose has taken on the responsibility for 40 000 tonnes of coal per year of Quintette's delivery and the new increased production rate at Bullmoose is 2 million tonnes per year.

The Quintette mine of Quintette Coal Limited (a subsidiary of Teck Corporation) also supplies metallurgical coal to the Japanese steel industry, employing a workforce of approximately 1000. The operation is currently running very well with productivity and profits up. Production is forecast to be lower this year at about 4.3 million tonnes because of the increased production at Bullmoose.

In the East Kootenay coalfields, the dominant story is the rebound from the disastrous year in 1992. There have been successful start-ups at the two former Westar mines, Balmer (now called Elkview) and Greenhills, under new owners. Nevertheless, the production rate and size of the workforce are down substantially at both sites. Fording River, shut down for most of 1992 by a strike, was working at capacity this year.

At the Fording River mine, owned by Fording Coal Limited, the dragline was moved to its new location in Honretta pit, north of the main operations area on Eagle Mountain. Production is at capacity of 6.5 million tonnes per year of predominantly metallurgical coal for Pacific Rim and other world markets, but also includes some thermal coal which is sold to various markets, including Ontario Hydro. The workforce is estimated at close to 1000. The mine has a healthy reserve. In 1993 Fording also carried out a large exploration program, which included deep drilling on that part of the property which adjoins the newly acquired Greenhills mine.

At the Greenhills mine 1993 production of both metallurgical and thermal coal for Pacific Rim and other overseas markets is forecast to be in the order of 1.35 million tonnes, about 40% of previous production. The company expects to mine 2.4 million tonnes in 1994 and reach full capacity of 3 million tonnes in 1995. Fording has electrified the pits and developed a new mining plan, based on larger scale equipment and merging of smaller pits into large ones. The workforce at present is about 350.

At the Line Creek mine, Line Creek Resources Ltd. (a subsidiary of Manalta Coal Ltd.) continued to produce both metallurgical and thermal coal for Pacific Rim and other overseas markets at a relatively consistent rate of 2.6 million tonnes per year, about 13% below capacity. Extensive exploration was conducted in 1993 to prove up new reserves within and close to its Mining Lease, with the main focus on Horseshoe Ridge which is on the other side of Line Creek and to the east of the Main pit. The workforce is estimated at 450.

At the Elkview mine, new owner Elkview Coal Corporation (a subsidiary of Teck Corporation) has re-established markets for metallurgical coal in Japan and continued to pursue new markets. Planned production is 2.7 million tonnes this year.

At the Byron Creek mine, new owner Corbin Creek Resources Ltd. (owned by former Esso Resources Ltd. mine staff) currently sells some thermal coal to Line Creek. The mine has lost its main thermal coal contract with Ontario Hydro. Production in 1993 is forecast at 0.5 million tonnes, well below capacity and new marketing efforts are underway for thermal coal and weak coking coal overseas.

At the Quinsam mine on Vancouver Island, Hillsborough Resources Ltd. planned to increase production of steam coal to 60 000 tonnes in 1993 with a further increase to 1 million tonnes in 1994. Quinsam coal is currently barged to a port facility on Texada Island for export to Japanese utilities and cement companies; however, Hillsborough has plans to build a port facility north of Campbell River. The company is also examining potential markets in the United States.

## ADVANCED EXPLORATION AND DEVELOPMENT PROJECTS

A number of exploration projects have advanced to or are approaching the development stage. The projects described in this section are shown in Figure 8 and listed with reserves in Table 3.

The Eskay Creek project is now owned 100% by Prime Resources Group Inc. which is controlled by Homestake Canada Ltd. A feasibility study released September 24, 1993 indicates proven and probable reserves for the 21B zone are 1.09 million tonnes grading 65.14 grams per tonne gold, 2949 grams per tonne silver, 5.6% zinc and 0.77%

copper, for a total *in situ* resource of 71 000 kilograms (2 300 000 ounces) of gold and 3214 tonnes (102 000 000 ounces) of silver. Cash operating costs for the underground mine operation are anticipated to be US \$108 per ounce gold equivalent, net of base metal products. The cost of developing Eskay Creek is estimated to be close to \$300 million. Conventional mining and grinding methods and a pressure oxidation (autoclave) circuit will be used to recover precious metals at a daily mill throughput of approximately 360 tonnes. Prime is examining a number of options for treatment of the ore including treatment at the Equity Silver mine site located near Houston, and on-site milling. The feasibility study indicates optimum annual production rates would be 7465 kilograms (240 000 ounces) of gold and approximately 326 600 kilograms (10.5 million ounces) of silver. By product zinc and copper production would be 5 400 tonnes and 800 tonnes respectively.

Preparation of an application for a Mine Development Certificate is well underway with submission of the application to the provincial government scheduled for November 1993. Road construction up Volcano Creek to the minesite has begun. Commercial production could begin by late 1995 or early 1996. During the 1993 field season Homestake conducted a property-wide and regional exploration program, estimated to have cost \$1 million, testing numerous zones of mineralization and refining the Eskay Creek stratigraphy.

In 1993 Lac Minerals Ltd. carried out the largest exploration program in the province, with expenditures estimated at \$7.5 million on its Red Mountain project (Plate 1). In 1992 Lac reported reserves of 2 539 600 tonnes grading 12.8 grams per tonne gold and 38.1 grams per tonne silver at a cut-off grade of 3 grams per tonne gold for a resource in excess of 31 100 kilograms (1 million ounces) of gold in two zones. During 1993 the company completed a surface drilling program in excess of 28 800 metres, together with 780 metres of underground development and planned to complete 12 300 metres of underground drilling. Total exploration expenditures on the property to the end of 1993 are estimated at \$15 million. In a news release dated September 24, 1993 Lac Minerals announced the discovery of two new zones which have added to the geological resource and indicate the potential for the delineation of more than 62 200 kilograms (2 million ounces) of gold. The new zones, the JW zone located below the AV zone and the 141 zone located southwest of the Marc zone, were identified by surface drilling. Gold grades and widths in these new zones are consistent with those already encountered in the Marc and AV zones. An extensive sampling program is in progress. Additional work on the metallurgical, engineering and environmental aspects of the project is continuing in advance of a feasibility study later this year. A new gold resource estimate is expected by year-end. A prospectus, based on the 1992 reserve estimates, was submitted to the Mine Development Assessment Process in May 1993.

The Tulsequah Chief and Big Bull projects, located 75 kilometres northeast of Juneau, Alaska, were explored by Redfern Resources Ltd. with total expenditures estimated at \$2.7 million. A pre-feasibility study on the Tulsequah Chief deposit determined that the deposit can become a viable mine based on drill-indicated mineable reserves, with 18% dilution, estimated at 6.93 million tonnes grading 1.40% copper, 1.07% lead, 6.42% zinc, 2.40 grams per tonne gold and 93.37 grams per tonne silver. The proposed production rate is 2250 tonnes per day. Total capital investment, exclusive of permitting, is forecast at \$138 million pre-production with an additional \$27 million over the nine-year life of the mine. The 1993 underground program of fill-in and exploratory drilling, primarily on the main H lens, confirmed the tonnage estimates and increased the overall grade by an estimated 5 to 10%. The deposit remains open to depth. In addition, Redfern completed an extensive program of line-cutting and induced polarization surveys over several areas between the Big Bull and Tulsequah Chief sites. Two chargeability and resistivity anomalies coincident with mapped zones of intense alteration were drilled. At the Big Bull site, Redfern completed a two-phase drilling program consisting of eleven holes designed to test for mineralization at depth and along strike to the southeast. Definition of mineable reserves at Big Bull could add significantly to the viability of the Tulsequah Chief deposits.

On the Sulphurets (Bruceside) project, owned 60% by Newhawk Gold Mines Ltd. and 40% by Granduc Mines Ltd., more than 3300 metres of surface drilling were completed on the SG, Galena Hill, Shore, Gossan Hill and Maddux zones at an estimated cost of \$1 million. Results have confirmed the orientation of ore-bearing structures and provided increased confidence in the zones which are all open along strike and down dip. An estimation of a total mineral inventory for all mineralized zones is currently in progress. On April 14, 1993 the company received its Mine Development Certificate from the provincial government, based on reserves in the West zone totalling approximately 750 000 tonnes grading 15.4 grams per tonne gold and 678 grams per tonne silver. Further underground exploration to test the high-grade R-8 structure below the West zone is planned for 1994 together with continued follow-up in other zones.

During the 1960s and early 1970s several drilling programs were carried out on the Huckleberry porphyry copper-molybdenum prospect. In 1992 New Canamin Resources Ltd. completed an agreement with Kennecott Canada Inc. and carried out further drilling focused on the high-grade core within the Main zone. New Canamin arranged for engineering and reserve calculation studies and in January 1993 the company filed a pre-application prospectus with the Mine Development Assessment Process.

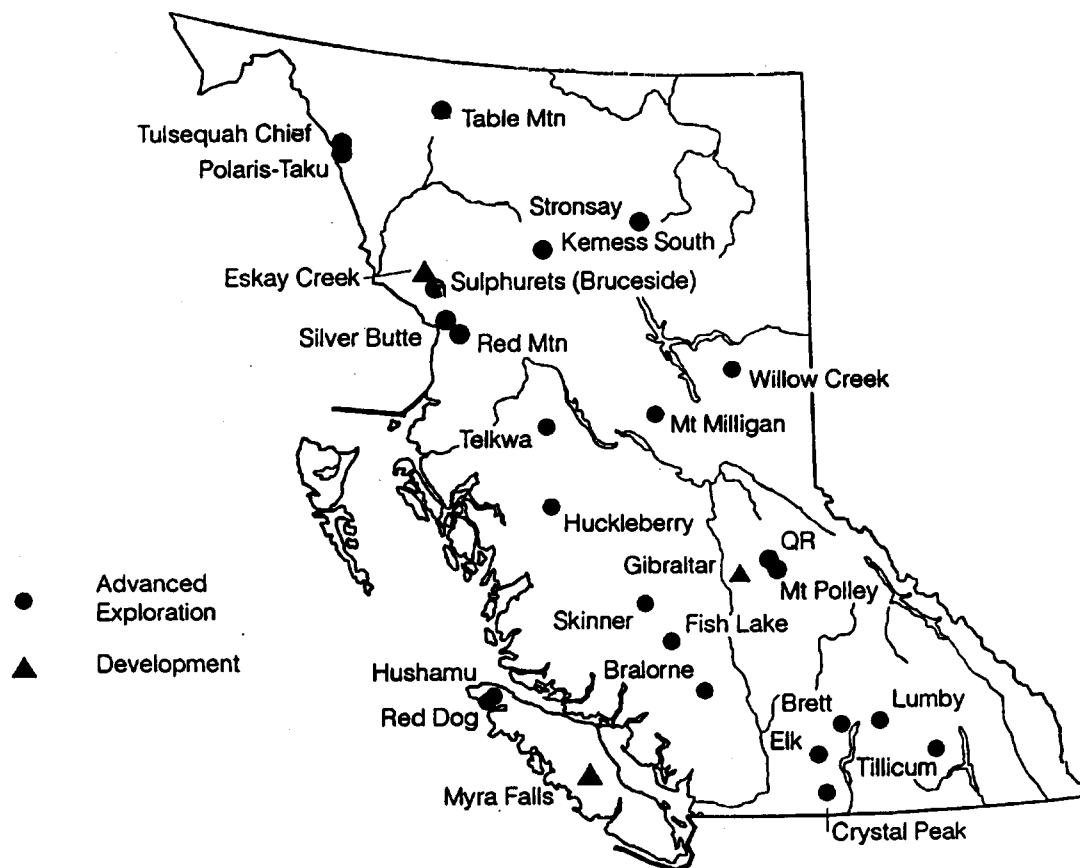


Figure 8. Advanced exploration and development projects.

**TABLE 3**  
**NEW MINES, CLOSURES, DEVELOPMENT AND**  
**ADVANCED EXPLORATION PROJECTS**

Company Name	Project Name	Commodity	Estimated Tonnes (000s)	Estimated Grade	Reference	Estimated Employment
<b>New Mines</b>						
None						
<b>Closures (Indefinite)</b>						
Cheni Gold Mines Ltd	(Lawyers)	Au,Ag				45
Sable Res. (DuPont)	Baker	Au,Ag				20
Princeton Mining Corp.	Cassiar	Asbestos				
Timmins Nickel Inc./	(Dome Mtn.)	Au,Ag				50
Habsburg Res. Inc.						
Similco Mines Ltd.	(Similco)	Cu,Au				265
<b>Development (Production Decision Announced)</b>						
Westmin Res. Ltd.	Myra Falls/ Battle zone	Cu,Pb,Zn, Ag,Au	3000	2.9% Cu, 0.4% Pb, 14% Zn, 24 g/t Ag, 1.0 g/t Au	Westmin, Oct. 1992	459
Prime Res. Group Inc.	Eskay Creek/ 21B zone	Au,Ag	1000	65.14 g/t Au, 2949 g/t Ag, 5.6% Zn, 0.77% Cu	Homestake, Sept. 1993	250
Gibraltar Mines Ltd.	Gibraltar (Expansion)	Cu	147 500	0.3% Cu, 0.0084% Mo	Gibraltar, 1993	285
<b>Advanced Exploration</b>						
<b>Coal and Industrial Mineral Deposits</b>						
Manalta Coal Ltd.	Telkwa	coal	38 670	thermal		
Globaltex Coal Mining Corp.	Willow Creek	coal		thermal		
Quinto Mining Corp.	Lumby Plateau shear zone	Au, graphite, sericite	500	4.5 g/t Au	Quinto, 1993	50
Polestar Expl. Ltd.	Crystal Peak	garnet	40 000	78% garnet	Polestar MDAP,1991	
<b>Porphyry Deposits</b>						
Imperial Metals Corp.	Mt. Polley	Cu,Au	49 000	0.38% Cu, 0.55 g/t Au	Imperial Metals MDAP,1992	200
Taseko Mines Ltd.	Fish Lake	Cu,Au	870 000	0.23% Cu, 0.43 g/t Au	Taseko Mines, 1993	300+
El Condor Res. Ltd./ St. Philips Res. Ltd.	Kemess South	Cu,Au	200 400	0.22% Cu, 0.63 g/t Au	El Condor, MDAP, 1992	300+
Jordex Res. Inc.	Hushamu (Expo)	Cu,Au,Mo	173 250	0.27% Cu, 0.34 g/t Au, 0.01% Mo	Jordex, 1992	
Crew Natural Res.	Red Dog	Cu,Au	31 200	0.313% Cu, 0.45 g/t Au, 0.007% Mo	Crew Natural Resources MDAP, 1992	
New Canamin Res. Ltd.	Huckleberry Main zone East zone	Cu,Au	31 000 69 000	0.52% Cu 0.572% Cu	New Canamin, 1993	
Placer Dome Inc.	Mount Milligan	Cu,Au	298 400	0.22% Cu, 0.45 g/t Au	Placer Dome, 1992	

(TABLE 3 continued)

**Massive Sulphide Deposits**

Curragh Inc.	Stronsay (Cirque)	Pb,Zn,Ag	24 700	2.3% Pb, 8.5 % Zn, 50.8 g/t Ag	Curragh MDAP, 1991	300+
Redfern Res. Ltd.	Tulsequah Chief/ Big Bull	Cu,Pb,Zn, Au,Ag	6930	1.4% Cu, 1.07% Pb 6.42% Zn, 2.40 g/t Au, 93.37 g/t Ag	Redfern, 1993	

**Skarn Deposits**

Kinross Gold Corp.	QR	Au	1300	4.7 g/t Au	Kinross, MDAP, 1993	
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**Transitional and Vein Deposits**

Bralorne-Pioneer Gold Mines Ltd./ Avino Mines and Res. Ltd.	Bralorne Above 1000 level Below 1000 level	Au,Ag	292 673	12 g/t Au 8.2 g/t Au	Avino MDAP, 1992	50
Liquid Gold Res. Inc./ Huntington Res. Ltd.	Brett Bonanza zone	Au	2.3	100 to 120 g/t Au	Huntington, 1993	
Cusac Industries Ltd.	Table Mountain West Bain vein East Bain vein	Au	31.5 20	23.6 g/t Au 19.4 g/t Au	Cusac, 1993	
Rembrandt Mines Ltd.	Polaris-Taku	Au	2200	14.7 g/t Au	Rembrandt, 1993	
Newhawk Gold Mines Ltd.	Sulphurets (Bruce side) West zone	Au,Ag	750	15.43 g/t Au, 647.2 g/t Ag	Newhawk MDAP, 1993	50 - 60
Fairfield Minerals Ltd.	Elk	Au	122.5	54.5 g/t Au, 24.68 g/t Ag	Fairfield, 1993	
Tenajon Res. Ltd./ Westmin Resources Ltd.	Silver Butte West Kansas zone	Au,Ag	?			
Lac Minerals Ltd.	Red Mountain	Au,Ag	2540	12.8 g/t Au 38.1 g/t Ag	Lac Minerals MDAP, 1993	

The prospectus was based on an indicated reserve of 40 million tonnes of which 24 million tonnes in the core of the Main zone were estimated to grade greater than 0.60% copper and 16 million tonnes surrounding the high-grade core were estimated to grade greater than 0.40% copper. Definition drilling in 1993 outlined a total Main zone reserve of 31 million tonnes grading 0.52% copper. During drill testing of the proposed tailing impoundment area, the East zone was discovered, approximately 1200 metres east of the Main zone. As of October 1, 1993, 10 650 metres of diamond drilling on the East zone has identified a drill-indicated and inferred mineral inventory of 69 million tonnes grading 0.572% copper within which there is a higher grade core of 31 million tonnes grading 0.64% copper. New Canamin also completed an airborne geophysical survey which outlined several anomalies, some of which were to be drill tested in the fall. A revised prospectus is

expected to be filed with the provincial government in 1994.

In August 1993 Taseko Mines Limited filed a pre-application for a Mine Development Certificate for its Fish Lake porphyry copper-gold project. Systematic diamond drilling of 68 000 metres on 100-metre centres in 1991 and 1992 has outlined a mineral inventory of 1279 million tonnes grading 0.22% copper and 0.42 gram per tonne gold, at a cut-off of 0.30% copper equivalent. Preliminary mineable reserve estimates range up to 870 million tonnes grading 0.23% copper and 0.43 gram per tonne gold. A proposed initial milling rate of 54 400 tonnes per day could produce an average of 43 630 tonnes of copper and 7120 kilograms of gold per year. Detailed mine planning and pre-feasibility studies are expected to be completed by year end.

At the Kemess South project, El Condor Resources Ltd. (60%) and St. Philips Resources Inc. (40%) completed

a detailed pre-feasibility study in 1993. A prospectus was filed with the provincial government in March 1992. Mineable reserves are estimated at 200 440 000 tonnes of hypogene and supergene ore at an average grade of 0.22% copper and 0.63 gram per tonne gold. At a proposed daily milling rate of 40 000 tonnes, the company forecasts the average annual production would be 6625 kilograms gold, 25.9 million kilograms of copper and 5288 kilograms of silver. Capital costs for the mine are estimated at \$374 million. An application for a Mine Development Certificate was expected to be submitted to the provincial government in the fall with production planned for late 1996.

Placer Dome Inc. continued to evaluate the viability of its large Mount Milligan porphyry copper-gold property with reserves estimated at 298.4 million tonnes grading 0.22% copper and 0.45 gram per tonne gold. The company estimates the deposit contains recoverable resources of 544 million kilograms of copper and 93 300 kilograms of gold. Pre-feasibility studies, based on an average milling rate of 68 900 tonnes per day, indicate annual production would average 45.4 million kilograms of copper and 7776 kilograms of gold. Capital costs were projected in the \$500 to \$600 million range.

Imperial Metals Corporation continues to seek financing to develop its Mount Polley porphyry copper-gold

property with reserves estimated at 49 million tonnes grading 0.38% copper and 0.55 gram per tonne gold. At a daily mill feed of 13 700 tonnes the annual output is forecast to be 13.6 million kilograms of copper and 3100 kilograms of gold. Capital costs are estimated at \$150 million. A Mine Development Certificate was issued in October 1992.

In a restructuring program CMP Resources Ltd. merged with affiliated companies, leaving the QR gold project in the hands of Kinross Gold Corporation. The project has a government Approval-in-Principal in good standing until July 1995 and an amendment is currently under review. Total reserves in three separate and widely spaced zones are estimated at 1.3 million tonnes grading 4.7 grams per tonne gold. Output at a daily milling rate of 800 tonnes is projected at 1.2 million grams of gold per year at a cash operating cost of about US\$220 per ounce. Kinross has applied to change the Approval-in-Principal to a Mine Development Certificate.

The Polaris-Taku gold project lies directly across the Tulsequah River from the Tulsequah Chief site. At the end of 1992 possible geological reserves in three major vein systems were estimated at 2.2 million tonnes grading 14.7 grams per tonne gold. All three systems remain open to depth and along strike. A diamond drilling program was carried out in the spring. Rembrandt Gold Mines Ltd., which

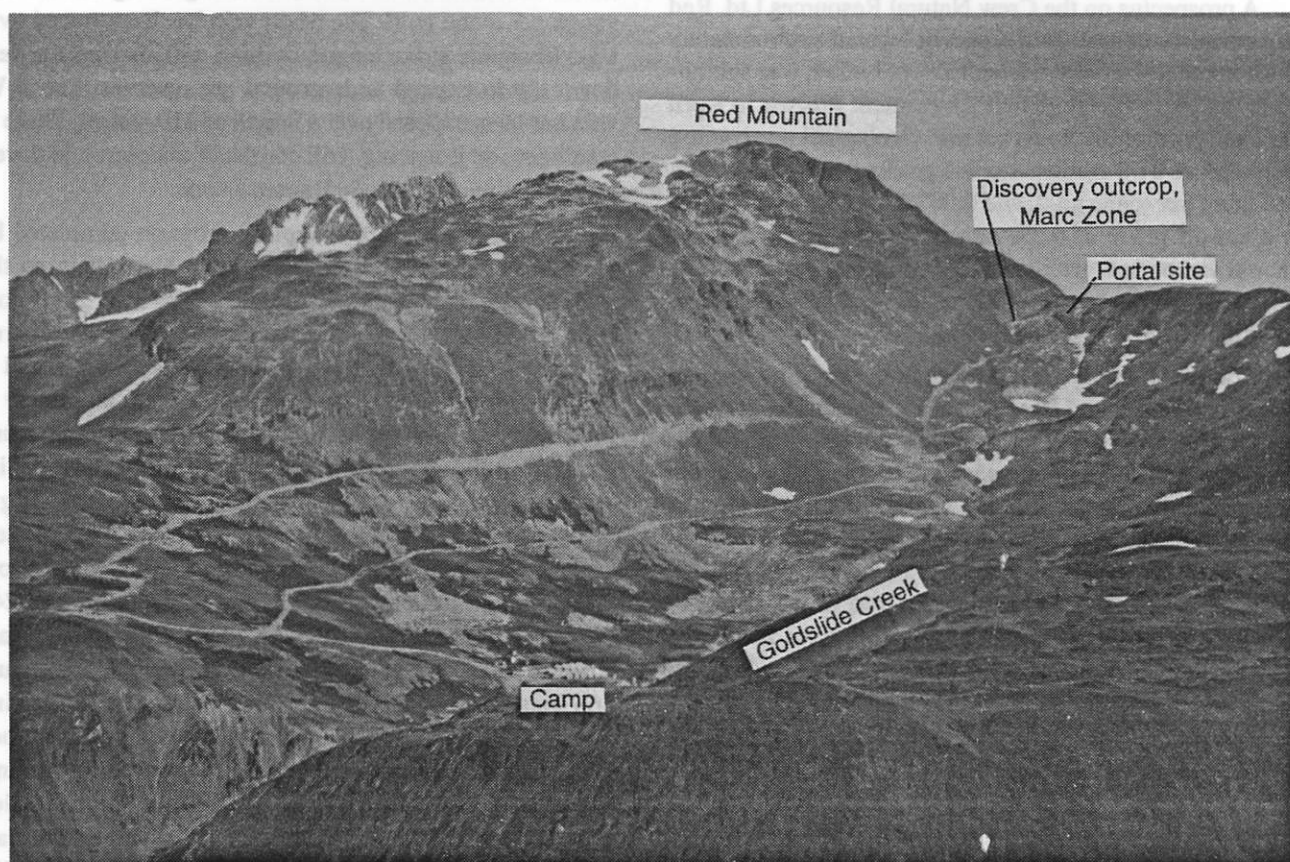


Plate 1. Looking northeasterly towards Red Mountain.

now has 100% control of the property, is pursuing development options.

In December 1992, Curragh Inc. was issued a Mine Development Certificate for its Stronsay (Cirque) lead-zinc-silver project. At a daily milling rate of 3500 tonnes the company estimated that the project would produce about 250 000 tonnes of zinc and lead sulphide concentrates yearly. Reserves in the North orebody are estimated at 24.7 million tonnes grading 2.3% lead, 8.5% zinc and 50.8 grams per tonne silver. Capital costs are estimated at \$130 million for on-site development and construction, plus \$37 million for off-site infrastructure and facilities. The property is in the hands of a Receiver and several companies have expressed interest.

On its Hushamu (Expo) porphyry copper-gold project located approximately 20 kilometres west of the Island Copper mine, Joralex Resources Ltd. completed a pre-feasibility study based on proven and probable reserves of 173 237 000 tonnes grading 0.27% copper, 0.009% molybdenum and 0.34 gram per tonne gold. The company estimates projected annual production at a daily milling rate of 50 000 tonnes in the Island Copper concentrator would be 45.5 million kilograms of copper, 3900 kilograms of gold and 1 million kilograms of molybdenum. Various methods of transporting the ore to the Island Copper mill are being investigated, including a conveyor system.

A prospectus on the Crew Natural Resources Ltd. Red Dog porphyry copper-gold property, located approximately 35 kilometres west of the Island Copper mine, was submitted to the Mine Development Assessment Process in April 1992 and is currently under review. Geological reserves are estimated at 31.2 million tonnes grading 0.313% copper, 0.45 gram per tonne gold, and 0.007% molybdenum, based on a cut-off grade of 0.2% copper. In March 1993, Crew Natural Resources made a formal proposal to BHP (Canada) Ltd. regarding the custom milling and beneficiation of ore at the Island Copper operation.

Bralorne-Pioneer Gold Mines Ltd., in a joint venture with Avino Mines and Resources Ltd., conducted a trenching and surface drilling program designed to locate extensions and prove reserves in the Peter and Mileikuk vein systems on the Bralorne mine (King mine) property. In 1992 Avino filed a prospectus with the provincial government based on proven and possible reserves of 292 000 tonnes grading 12 grams per tonne gold in the Bralorne mine above the 1000 level. Additional reserves below the 1000 level are estimated at 673 000 tonnes grading 8.2 grams per tonne gold. Also, two veins on the Loco prospect are estimated to contain 362 800 tonnes grading 17.2 grams per tonne gold.

Cusac Industries Ltd. secured financing to place the Table Mountain gold project back in production. Cusac bought the property from Energold Minerals Inc. earlier this year. Reserves are estimated at 31 510 tonnes grading 23.6

grams per tonne gold for the West Bain vein and 20 060 tonnes grading 19.4 grams per tonne gold for the East Bain vein. A modern 275 tonne per day flotation and gravity concentrator is on the property. The capital cost estimated to develop the reserves is \$3.8 million. The camp has been winterized and a 230-metre decline to the West Bain vein has been collared. Milling is expected to begin next spring with cash production costs estimated at \$160 per ounce. The company also plans to dewater the decline at the old Cusac mine to test a preliminary reserve of 22 675 tonnes grading in the order of 34 grams per tonne gold.

Underground exploration continued on the Tenajon Resources Corporation and Westrain Resources Limited West Karsus zones on the SB (Silver Butte) gold project in the Stewart area. Bulk sampling for test milling was conducted at Westmin's adjacent Premier mill. In an effort to define the underground bulk-tonnage potential, underground development and definition diamond drilling will continue.

Huntington Resources Ltd. (50%) and Liquid Gold Resources Inc. (50%) conducted a two-phase exploration program including reverse circulation drilling designed to test the grade and structure along the Main zone shear and R.W. vein to establish open pit reserves on their Brett gold property. The Bonanza zone in the Main zone shear is estimated to contain some 2270 tonnes grading 100 to 120 grams per tonne gold. The Main vein has been traced over a 1.5 kilometre strike length. Drilling will also test the vein down dip to expand underground ore reserves. The R.W. vein has been exposed over a length of 210 metres. Phase 3, contingent on financing, will consist of underground development on the high-grade Bonanza zone.

During 1992 a bulk sampling program completed by Fairfield's Minerals Ltd. on the Siwash North vein on the Elk property yielded 270 600 grams (8700 ounces) of gold from 1840 tonnes of concentrate treated at the Horne smelter at Noranda, Quebec. Total costs were estimated at \$250 per ounce gold. Drill-indicated reserves at January 1, 1993 were 122 445 tonnes grading 54.5 grams per tonne gold. The 1993 program, expected to cost \$3.5 million, included expansion of the existing open pit, driving a 305-metre decline to 46 metres below surface, and underground test mining with bulk sampling. Gold recovery from a 4080-tonne bulk sample was expected to be 373 240 grams (12 000 ounces) of gold, generating a significant positive cash flow which will assist in meeting preproduction capital requirements. The company is considering where the new bulk sample will be treated; options include the Horne smelter and the ASARCO smelter at Helena, Montana. An on site alternative would include construction of a 110 tonne per day plant to produce a gold concentrate with the end product being doré. In 1994 a further 777 600 grams (25 000 ounces) is forecast to be recovered from

9070 tonnes of high-grade ore. The deposit remains open at depth.

Bethlehem Resources Corporation and Goldnev Resources Inc., in agreement with Columbia Gold Mines Ltd., together mined a 5400-tonne bulk sample with an estimated grade of 24 grams per tonne gold from the high-grade Heino-Money zone on the Tillicum property. Reserves are estimated at 13 600 tonnes at about 34 grams per tonne gold. The ore will be processed at the Goldstream concentrator. An application for a mining lease has been made which will allow the mining of ore in excess of the currently approved 9000 tonnes. Under the agreement, the joint venture also has an option to earn a 50% interest in the remaining area of the Tillicum property, specifically the East Ridge deposit with total drill-indicated and inferred reserves estimated at 1 184 540 tonnes grading 5.83 grams per tonne gold, including 439 900 tonnes grading 10.29 grams per tonne gold.

A 172-tonne bulk sample mined by Ottarasko Mines Ltd. from its Skinner gold property yielded 11 350 grams (365 ounces) of gold and 4850 grams (156 ounces) of silver. The ore was processed at Westmin Resources Limited's Premier mill near Stewart. Gold recovery was estimated to be 98.9% and the total costs were \$197 per ounce. In 1992 a similar custom milling program yielded 8335 grams (268 ounces) from 142 tonnes of ore.

The Crystal Peak high-grade garnet project, operated by Polestar Exploration Ltd., remains in the Mine Development Assessment Process with land-use and First Nations' concerns still to be resolved.

Quinto Mining Corporation conducted exploration and bulk sampling on its Lumby (Chaput) gold and graphite-sericite property. The end product graphite and sericite, is being tested as a filler for plastics and composite materials. Underground mining began late in the year. A drill-indicated reserve is estimated at 507 920 tonnes grading 4.5 grams per tonne gold using a cut-off grade of 2 grams per tonne; there was no estimate of the value of the graphite and sericite. If further tests are as encouraging as recently completed laboratory results then the company plans to expand the existing plant to perhaps 275 to 300 tonnes per day during 1994. At the same time it will seek to negotiate long term sales contracts.

## COAL

In 1993 Manalta Coal Ltd. conducted a \$700 000 exploration program on its Telkwa coal project designed to follow up its 1992 discovery in the Teems Creek area, to explore the area east of Pit 7 reserves, to extend the limits of Pit 8 reserves, to conduct infill drilling on Pit 3 reserves, and to conduct geophysical surveys and drilling on proposed plant and tailings disposal sites. Geological reserves of thermal coal are estimated to be 38.7 million tonnes. The

application to the Mine Development Assessment Process, originally filed in 1990, has been re-activated for review.

At the Willow Creek thermal coal property in the Northeast coalfields, Globaltex Coal Mining Corporation bulk sampled test pits to investigate the potential for underground mining.

## HIGHLIGHTS OF EXPLORATION PROJECTS

Gold-enriched porphyry copper deposits, polymetallic massive sulphide deposits (volcanogenic and sedex), and veins and transitional deposits accounted for approximately 85% of 1993 exploration expenditures in British Columbia. The remainder were directed to coal, industrial minerals, skarn, diamonds and less traditional targets such as sedimentary copper and auriferous iron formations. Although most of the exploration programs were focused in and around areas with mines or known showings and existing infrastructure, several new, relatively low budget, regional programs were conducted throughout the province. These keyed on: sedex deposits in the southeast (especially in the Purcell Supergroup) and northeast (e.g. Gataga-Driftpile area); diamonds in the Rocky Mountains; gold deposits in the Interior area of south-central British Columbia; porphyry deposits in the Babine Lake area and epithermal precious metal veins and transitional deposits in the Stewart Camp in the northwest. Some of these projects have advanced very quickly and are mentioned in the previous section (i.e. Huckleberry, Red Mountain). The diversity of targets, their large size (some world class, such as Highland Valley Copper and Sullivan), and the profitable nature of smaller higher grade deposits such as Snip continue to make British Columbia a good place to explore. The properties mentioned below are shown on Figure 9 and listed in Table 4, with estimated preliminary reserves, where available.

## PORPHYRY COPPER-GOLD DEPOSITS

At the Hearne Hill deposit located close to the recently closed Bell Copper mine in the Babine Lake area, Booker Gold Explorations Ltd. completed trenching, a detailed magnetometer survey, and follow-up drilling on two breccia-pipe zones. When Booker acquired the property in late December 1992, previous drill-indicated and inferred reserves in the main breccia body located within a large, low-grade porphyry system were estimated at 180 000 tonnes grading 1.7% copper with recoverable gold values contained in the Discovery (Chapman) Zone. In January 1992, a prospectus for a Mine Development Certificate was filed on behalf of David Chapman. The proposal was to mine up to 45 000 tonnes of ore and transport it to the nearby Bell Copper concentrator for processing. The early closure of the Bell Copper mine was a setback to development plans. During the 1993 program, Booker discovered another breccia 120 metres northeast of the Discovery zone.

At the Lorraine porphyry copper-gold property, Kenecott Canada Inc. completed geological, geochemical and geophysical surveys and four diamond-drill holes. The program tested for extensions to and better gold grades in the Main zone (previous reserves estimated at approximately 10 million tonnes grading at 0.67% copper and 0.34 gram per tonne gold), and also the Extension zone discovered in 1991.

International Skyline Gold Corporation completed an induced polarization survey which identified an anomalous zone measuring 2500 by 460 metres on the Bronson Creek (Red Bluff) porphyry copper-gold deposit. Follow up drilling was designed to expand the geological potential of the area estimated to be in excess of 100 million tonnes on the basis of earlier drilling. In addition, Cominco Ltd. completed substantial geotechnical studies of the area under option from Skyline by the Snip joint venture. Drilling also tested extensions to the Twin vein on the Snip property.

Regional Resources Ltd. and GWR Resources Inc. consolidated a large area (150 square kilometres) of claims in the area northeast of Lac La Hache, around the Peach Lake, Spout Lake and Murphy-Miracle properties. Work consisted of compilation, prospecting, reconnaissance geological mapping, geochemical sampling and induced polarization surveys. Targets include the Main (magnetite)

skarn, where drilling in early 1993 identified a reserve estimated at 544 200 tonnes grading 1.8% copper, 49% iron and 0.17 gram per tonne gold, the newly discovered Nemrude bornite skarn, the Miracle-Murphy alkalic porphyry copper-gold prospect and a calcalkalic porphyry prospect. Follow-up drilling is planned.

In the southern Toodoggone district, where the Kemess South porphyry copper-gold deposit is in an advanced stage of exploration and permitting, Romulus Resources Ltd. carried out two separate modest drilling programs on the Pine and Brenda porphyry copper-gold prospects. Romulus has an option agreement with Electrum Resources Ltd. and Canasil Resources Inc. for their respective properties. The four holes on the Brenda property intersected stockwork gold-copper mineralization near the surface and over substantial intervals. Previous work by Canasil has identified epithermal gold-silver mineralization in volcanic rocks in the western section of the property. On the Pine property follow-up drilling tested geochemical and geophysical targets in areas of strong quartz-sericite-magnetite alteration.

At the Poison Mountain porphyry copper-gold-molybdenum prospect, Bethlehem Resources Corporation drilled nine holes on two areas outside the Copper Creek zone where reserves of 280.8 million tonnes grading 0.31% copper, 0.142 gram per tonne gold and 0.007% molybdenum

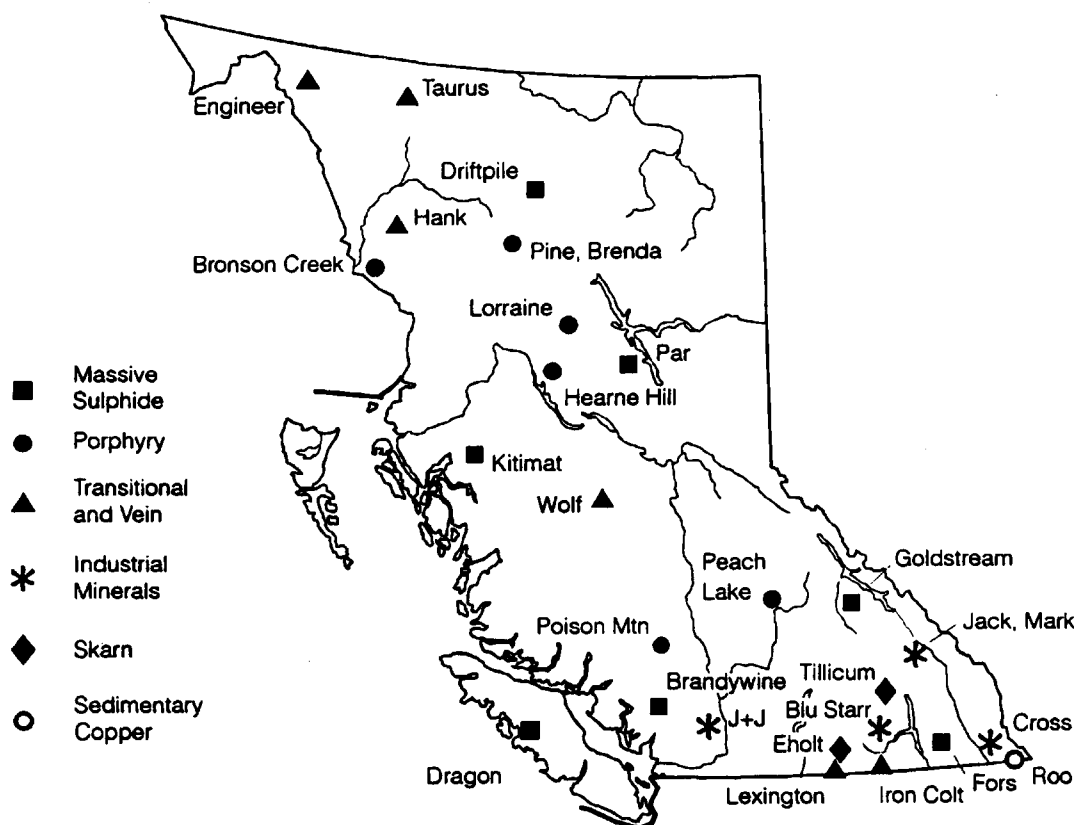


Figure 9. Exploration highlight projects.

**TABLE 4**  
**1993 EXPLORATION HIGHLIGHTS**

Company Name	Project Name	Commodity	Estimated Tonnes (000s)	Estimated Grade	Reference	Exploration Expenditures (\$Millions)
<b>Massive Sulphide Deposits</b>						
American Bullion Minerals Ltd.	Kitimat	Cu,Pb,Zn, Au,Ag			News Release, 1993	0.5
Kokanee Explorations Ltd./ Consolidated Ramrod Gold Corp.	Fors	Pb,Zn,Ag				0.5
La Rock Mining Corp.	Brandywine	Cu,Pb,Zn, Au,Ag				0.3
Teck Corp.	Driftpile	Pb,Zn,Ag	20 000	2.4% Pb + Zn	NM, Oct. 18/93	0.375
<b>Porphyry Deposits</b>						
Bethlehem Resources Corp.	Poison Mountain	Cu,Au,Mo	280 800	0.31% Cu, 0.142 g/t Au, 0.007% Mo	SW, Oct. 28/93	0.2
Booker Gold Explorations Ltd.	Hearne Hill	Cu,Au	180	1.7% Cu	Prospectus MDAP, 1992	0.15
International Skyline Gold Corp.	Bronson Creek	Au			SW, Jun. 24/93	0.25
Kennecott Canada Inc.	Lorraine	Cu,Au	10 000	0.67% Cu, 0.34 g/t Au	Kennecott, 1993	0.3
<b>Skarn Deposits</b>						
GWR Resources Inc./ Regional Resources Inc.	Peach Lake/ Spout Lake	Cu,Au	554.2	1.8% Cu, 0.17 g/t Au,	SW, Mar. 4/93	0.45
Orvana Minerals Corp./ Placer Dome Inc.	Eholt/Motherlode/ Thimble Mtn.	Au,Cu				0.2
<b>Transitional and Vein Deposits</b>						
Bethlehem Resources Corp.	Tillicum Heino-Money East Ridge	Au	13.6 440	34.79 g/t Au 10.26 g/t Au	Columbia Gold Mines, 1991	0.3
Britannia Gold Corp.	Lexington-Lonestar Lonestar zone Northwest zone Main zone	Au,Cu	17 600 900 1000	0.52% Cu, 0.3 g/t Au 1.04% Cu, 1.0 g/t Au 0.93% Cu, 4.5 g/t Au	Britannia, 1993	0.25
Hera Resources Inc.	Taurus	Au	270	7.2 - 8.6 g/t Au	SW, Oct. 27, 1993	0.175
Homestake Canada Ltd.	Hank 200 pit 400 pit	Au,Ag	245 220	4 g/t Au 2 g/t Au	Lac Minerals, 1989	0.25
International Silver Ridge Resources Inc./ Vangold Resources Inc.	Iron Colt	Au,Ag				0.075
Metall Mining Corp.	Wolf	Au,Ag				0.14
Winslow Gold Corp.	Engineer	Au	20	34 g/t Au	SW, Oct. 15, 1993	0.1

Note: NM = Northern Miner; SW = Stockwatch

have been outlined by previous operators. Eight holes tested and confirmed the Fenton Creek zone where computer modelling of previous drill information indicated the potential for approximately 40 million tonnes of copper-gold mineralization. The ninth hole tested a strong gold anomaly in soils.

### **POLYMETALLIC MASSIVE SULPHIDE DEPOSITS**

Both base metal rich (sedex and volcanogenic) and precious metal rich (volcanogenic) massive sulphide deposits were important targets. The success of projects at Myra Falls (Battle zone), Tulsequah Chief, Eskay Creek and Fors over the past few years bear good testimony to the exploration potential of these deposit types.

In the Gataga district Teck Corporation tested a zone of stratabound zinc and lead mineralization at the Driftpile property in the Williston Lake area of northeastern British Columbia. Previous drilling had resulted in the discovery of a geological resource estimated at 20 million tonnes of 2.4% combined lead-zinc. Teck's 1993 program followed up three isolated drill holes with better grades outside the known resource. This drilling intersected a mineralized horizon now interpreted to be on the other limb of a synclinal structure. Teck hopes that the target proves to be at least the same size as the Stronsay (Cirque) deposit located about 100 kilometres to the south within the same belt of favourable rocks. Drilling at Driftpile is expected to resume next June. Also in the immediate area of the Stronsay deposit, Metall Mining Corporation (under an option agreement with Ecstall Mining Corporation), explored the YN, Pie and Akie claim blocks for sedex mineralization. On the YN claims a five-hole diamond drilling program tested strong multi-element soil anomalies and a barite horizon. On the Pie and Akie claims geochemical and geological surveys were completed. In 1989 and 1990 Teck Corporation drilled the Mount Alcock stratiform lead-zinc-barite deposit located immediately to the north of the Stronsay deposit, in the Kwadacha Wilderness Recreation Area. The drilling tested a 300-metre strike length with assays returning up to 6.9% combined lead and zinc over a core length of 10.5 metres. A deep gravity anomaly remains untested.

At the Brandywine property located approximately 5 kilometres southwest of the Northair mine and 48 kilometres north of the Britannia mine, La Rock Mining Corporation continued diamond drilling in the Main zone (Tedi pit area) and the recently discovered Dave's Pond showing, in its search for a Britannia-style deposit. The showing is hosted in a flat-lying quartz-sericite schist about 300 metres to the northeast of the Main zone. Drilling in the Dave's Pond zone has shown the presence of significant free native gold together with base metal sulphides. On-going drilling is testing the dimensions and continuity of the prospect.

In the Osilinka River area northeast of Germansen Landing, Cominco Ltd. completed a five-hole diamond

drilling program on its Par property as a follow up to good results from a 1991 trenching program and an inconclusive 1992 drilling program. The drilling tested lead, zinc and silver mineralization with associated barite in structurally complicated Paleozoic carbonates with minor clastic components.

In the Kitimat area, American Bullion Minerals Ltd. explored a 12-kilometre felsic volcanic belt that hosts over 20 occurrences with characteristics of a polymetallic volcanogenic massive sulphide setting. Work completed included airborne electromagnetic and magnetic surveys followed by ground geochemical and geophysical surveys and mapping, sampling, trenching and diamond drilling on three targets.

In the Purcell Mountains of southeastern British Columbia, Consolidated Ramrod Gold Corporation., with joint venture partners Chapleau Resources Ltd. and Barkhor Resources Inc., continued drilling on the Fors and Vine massive sulphide prospects, located in the Moyie Lake area 60 kilometres south of the Sullivan mine. The Sullivan horizon has been intersected by ten widely spaced diamond-drill holes which roughly outline an area of hydrothermal alteration and mineralization. The thicknesses of breccia, basal muds, and intense alteration similar in style to that seen at Sullivan are very encouraging and have helped spark other regional exploration programs.

On the Dragon polymetallic prospect located near Gold River on Vancouver Island, Noranda Exploration Inc. conducted a drilling program to test a felsic volcanic formation hosting numerous gold-bearing galena and sphalerite showings exposed over widths of 3 to 20 metres. Doromin Resources Ltd., which optioned the Dragon property to Noranda, has identified a new mineralized zone in a similar package of rocks on adjacent claims.

### **PRECIOUS METAL BEARING VEINS AND TRANSITIONAL DEPOSITS**

Exploration targets within this category cover a broad spectrum of hydrothermal, epigenetic mineral deposits. They include high-level epithermal deposits, deeper level mesothermal veins and those that form in the transitional zones between the porphyry environment and vein deposits at intermediate depths, including some skarns (e.g. Red Mountain).

On the Hank epithermal prospect located in the Iskut River area, Homestake Canada Ltd. conducted a diamond drilling program focused on a zone of acid sulphate alteration stratigraphically higher than previous drilling. Previous drilling of 96 holes by Lac Minerals Ltd. and Carmac Resources Ltd. outlined a geological reserve of 245 000 tonnes grading 4.0 grams per tonne gold and 218 000 tonnes grading 2.0 grams per tonne gold in the 200 and 400 pit areas, respectively.

At the Engineer epithermal gold mine west of Atlin, under an option agreement with Winslow Gold Corporation, Ampex Mining reaccessed the mine including underground rehabilitation of the previously inaccessible Governor vein. A bulk sampling program returned good grades on both the Engineer and Governor veins and visible gold was discovered in a number of places throughout the Engineer and Double Decker veins. Ampex believes that approximately 20 000 tonnes or more are readily available at an average grade of approximately 34.3 grams per tonne gold. With the hope that the Engineer, Double Decker and Governor veins have sufficient tonnage to support a smaller scale mining operation, Ampex plans to purchase a 50 tonne per day mill and bring the mine back into production in late 1994. Ampex is also testing the market for specimen sales.

On the Taurus mesothermal gold property near Cassiar, Hera Resources Inc. conducted a trenching program which exposed four new gold-bearing quartz veins extending up to 150 metres in length, west of the existing underground workings. Follow-up diamond drilling of twenty-six holes totalling approximately 1500 metres tested the vein system to depth. Based on positive results and the existing reserves estimated at 272 100 tonnes grading 7.2 to 8.6 grams per tonne gold, the company hopes to commence gold production at its 320 tonne per day mill in the near future.

On the Wolf epithermal gold prospect, located in the Interior Plateau region of central British Columbia, Metall Mining Corporation conducted detailed geological, geochemical and geophysical surveys with follow-up trenching. A major drilling program is planned for 1994. The prospect has potential for both bonanza and bulk-mineable deposits of the low-sulphidation adularia-sericite subtype of epithermal deposits hosted by Tertiary rhyolitic volcanic rocks.

In the Rossland Camp, International Silver Ridge Resources Inc. and Vangold Resources Inc. continued their underground program to explore, high-grade gold mineralization on the Iron Colt property. Two shear-hosted veins similar to those of the prolific Le Roi and other mines in the camp were exposed and are believed to be an eastern extension to the main Le Roi vein system where 93 310 kilograms of gold were mined from 1898 to 1941. Plans include a 4500-tonne bulk sample for test milling and blocking out sufficient reserves to support mining, with ore to be custom milled at the Standard mill at Slocan.

In the Greenwood Camp, Britannia Gold Corporation conducted a diamond drilling program on its Lexington-Lonestar property, testing for additional copper-gold mineralization. Previous reserves were estimated at 17.6 million tonnes grading 0.52% copper and 0.3 gram per tonne gold in the Lone Star zone, 0.9 million tonnes grading 1.04% copper and 1.0 gram per tonne gold in the Northwest zone, and 1.0 million tonnes grading 0.93% copper and 4.5 grams per tonne gold in the Lexington main zone. Mineable

reserves in the Main zone are estimated at 131 515 tonnes grading 9.6 grams per tonne gold and 1.45% copper. In 1993 drilling on the TG 81 zone, located approximately 200 metres north of the Main zone, was designed to test its continuity. Drilling in the Golden Cache area, approximately 3000 metres north of the Main zone, tested a significant magnetic anomaly associated with copper-gold mineralization. Although the property has open-pit potential, management is primarily focusing on developing the bulk-tonnage underground gold-copper potential.

### SKARN DEPOSITS

Also in the Greenwood Camp, Orvana Minerals Corporation and Placer Dome Inc. explored the Eholt, Motherlode and Thimble Mountain gold skarn properties which occur in a similar geologic setting to the old Phoenix mine. At Eholt drill testing by Orvana Minerals of an unusually large magnetic anomaly intersected a Triassic ash-fall tuff with anomalous gold and copper values associated with magnetite. At Motherlode drilling by Orvana Minerals intersected significant gold skarn mineralization within a sequence of Knob Hill cherts, including 10.9 metres grading 3.08 grams per tonne gold. At Thimble Mountain, Placer Dome's program, including trenching, further defined drill targets.

### INDUSTRIAL MINERALS

Exploration and market interest in industrial minerals continues to increase in part as a result of the continued slow-down in metallic minerals activity and in part as a trend towards diversification.

In southern British Columbia, particularly, new applications for various types of construction stone products have been advancing steadily. Among these are projects to produce marble, limestone and granitic dimension stone. There are development opportunities for such materials as aggregate, refractory and advanced ceramic minerals, talc, vermiculite, garnet and kaolin. High unit-value commodities such as magnesite and jade serve worldwide markets.

In the southern Fraser Canyon, Cromlech Ltd. recovered unconsolidated silica and feldspar sand at Scuzzy Creek, near Boston Bar. Quality Mineral and Industry Supply Co. Ltd. proposed to develop a sodic feldspar deposit at Sumas Mountain near Abbotsford.

Examples of successful, high-quality industrial mineral operations are the barite and silica mines of Mountain Minerals Ltd. (e.g. Mt. Moberly) near Golden. This company has been a long-established supplier of barite to the drilling industry and more recently for filter applications, and quartz to glass producers. Elsewhere in the region, Baymag Mines Company Limited produces magnesite (Mt. Brussiloff); gypsum is mined at Lussier River and Windermere by Domtar Construction Materials Ltd. and Westrock Industries Ltd. respectively. Lime for cement and

other industrial uses is produced by Lafarge Ltd. at Kamloops and Continental Lime Ltd. at Pavillion Lake. Limestone operations on Texada Island supply the cement and lime industries in the Lower Mainland of British Columbia, the Puget Sound area in Washington, and the Portland area in Oregon. Several small operations by IMASCO near Creston and in Surrey are a steady major supplier of white calcium carbonate filler for paints and plastic industries in the Pacific Northwest. The IMASCO operations at Benson Lake on Vancouver Island has been expanding their shipping/loading capacity in Port Alice.

New developments in 1992/1993 included: production of granite blocks from eight different sites in southwestern British Columbia by Märgronite Industries Ltd. and B.C. Granite Ltd.; production of marble from two sites on Vancouver Island by Leo D'Or Mines Ltd. and Matrix Marble Corp.; marketing of a zeolite deodorant/absorbent product from the Cache Creek area by Mountain Minerals Ltd.; the processing of cinder cone material at Nazko by Canada Pumice Ltd. primarily for barbecue products, and the processing and shipping of a 9000-tonne silica sample by New Global Resources Ltd. from its 'geyserite' pyrophyllite-quartz deposit located on tidewater at Easy Inlet on the west coast of Vancouver Island. New Global has submitted a prospectus seeking to obtain permits to quarry, crush, stockpile and ship between 70 000 and 100 000 tonnes of silica per year to the Tilbury Portland Cement Plant at Delta, B.C.

At the Pacific Talc Ltd. J&J talc property near Boston Bar, a new deposit was discovered that could add significantly to the previously estimated reserves sufficient for more than 40 years of production. A significantly large quantity of the talc to be produced from the J&J property is being targeted as a pigment in the paper industry of the Pacific Northwest.

The diamond frenzy, which has gripped the Northwest Territories, Alberta and Saskatchewan, spilled over into southeastern British Columbia. In the Crossing Creek and Boivan Creek areas, Consolidated Raremetal Gold Corporation explored chromium-nickel anomalies for undiscovered kimberlite intrusions on the west side of the Elk valley. The area contains the Cross kimberlite pipe and several associated kimberlite dikes on the Ice property. An airborne magnetic survey assisted in defining the limits of possible kimberlites. Speculative staking has occurred from the U.S. border northwards to beyond Golden. Similarly, the area of the Rossland Range between Christina Lake and Big Sheep Creek and from the U.S. border to Highway 3, has been staked for its diamond potential. Programs were carried out on the previously located diamondiferous Jack and Mark properties north of Golden.

At Passmore in the Slocan Valley, owners of the Blue Starr sapphire property continue to discover, process, and market their sapphires, gem-quality titanite and aquama-

rine, and high museum quality black and smokey grey quartz crystals.

## OTHER TARGETS

Both property-scale and regional exploration programs were conducted for sedimentary copper-cobalt-silver deposits in the southeast part of the province. Noranda Exploration Ltd. completed a modest drilling program on the Roo sandstone-siltstone (red bed) copper-cobalt prospect in the Sheppard Formation, on Phillips Creek near the Roosville border crossing.

## NEW INITIATIVES IN BRITISH COLUMBIA

Several new programs that will have a significant influence on future mineral resource planning, exploration and development in British Columbia were initiated in 1993.

On March 11, 1993 a *Mineral Strategy for British Columbia* was released by the Government of British Columbia to revitalize the exploration sector, improve industry competitiveness and maximize value-added opportunities. The strategy has eight key elements:

- Building Confidence
- Mineral Tenure Review
- Proactive Mineral Management
- Targeted Geological Support
- Rationalized Environmental and Regulatory Requirements
- Regional Economic Development
- Serving First Nations Interests
- Managing the Tax Burden

In April 1993, the Ministry's Mineral Resources Division was reorganized to increase its regional presence and to allow a more proactive role in land-use planning. Under the Corporate Resource Inventory Initiative, the Geological Survey Branch continued to prepare updated mineral potential maps for the Commission on Resources and Environment. The mineral potential assessment process includes the formation of methodologies, mineral deposit modeling and expert estimates of undiscovered resources, designed to rank the land base of British Columbia according to its ability to sustain mineral exploration and production. The Vancouver Island and Cariboo-Chilcotin studies were completed. The Kootenay regional studies are well advanced and studies began on the Nass-Skeena and Thompson-Okanagan areas.

The Geological Survey Branch programs were re-focused this year. Five integrated multi-disciplinary projects were carried out in regions where existing mines are forecast to close in the next few years (Northern Vancouver Island, Interior Plateau, East Kootenays, northern Selkirk and Tulsequah). Results of these programs are expected to encourage base metal exploration in these areas.

Discussions continued with the First Nations designed to provide them with a more equitable role in mineral exploration and development decision making within their traditional territories.

A new initiative by the Ministry of Energy, Mines and Petroleum Resources and B.C. Trade Development Corporation will stimulate the development of industrial minerals. The initiative will carry out promotional activities to reach industry representatives in British Columbia, Pacific Rim countries and Europe with the objective of developing new markets and attracting capital investment. Initial efforts will focus on promoting value-added refractory and ceramic minerals, and dimension stone. The provincial government has developed a Protocol Agreement between the Ministry of Energy, Mines and Petroleum Resources and the Ministry of Environment, Lands and Parks to streamline the administration of *industrial minerals* and *Crown Land quarry resources*.

### **SUMMARY AND OUTLOOK FOR 1994**

During 1993 the exploration industry in British Columbia concentrated on the evaluation of many previously explored targets, particularly near existing infrastructure. Several advanced projects received further work in anticipation of improved metal markets and favourable resolution of uncertainties in land-use policies. Several smaller, high-grade gold projects have and will continue to take advantage of the custom milling facilities available throughout the province by obtaining the necessary permitting for bulk sampling.

The many copper-bearing porphyry deposits discovered during the 1960s and 1970s continue to receive attention focused on the search for zones of higher grade

copper with or without gold credits. Copper prices will dictate their ultimate economic viability. Sedex and volcanogenic polymetallic massive sulphide deposits offer small to medium tonnage and high grade potential, particularly those enriched in precious metals. The stratiform, gold-enriched Eskay Creek deposits are examples of low tonnage, but potentially extremely profitable, high-grade targets. The transitional setting, which includes vein and skarn deposits (e.g. Red Mountain) offers similar small to medium tonnage and high grade potential. Exploration for both metallurgical and thermal coal has increased, as has the search for and development of industrial minerals products.

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