



MAY 2000

Mining

ENGINEERING
A PUBLICATION OF SME



1999

Annual Review

AmerAlia is applying for permits for another sodium bicarbonate solution mine in the Piceance Creek Basin. In January, the company announced that it had received approval from the BLM to proceed with mine development. In 1998, Calais Resources of British Columbia completed the purchase of the assets of Hendricks Min-

ing, including the Cross-Caribou mining project in the Grand Island district of Boulder County. The company conducted an exploration-drilling program during 1998. Results showed that there are 1.29 Mt (1.42 million st) of indicated resources grading 10.2 g/t (0.298 oz/st) gold and 282 g/t (8.23 oz/st) of silver on the property. ■

IDAHO

V.S. GILLERMAN and E.H. BENNETT, Idaho Geological Survey

The international downturn in metal prices during 1999 negatively affected Idaho's metal mining industry. Exploration was hard hit by low metal prices and the recessionary outlook of the global minerals industry, plus increased regulatory uncertainties associated with permitting on federal lands that comprise some 64% of Idaho. Endangered species and water quality were the major environmental issues.

However, three silver mines in the famous Coeur d'Alene district of north Idaho were in full production in 1999. So were increasingly important industrial minerals operations. Industrial minerals products were worth nearly a half-billion dollars to the Idaho economy.

Phosphate mining and processing, based in southeast Idaho, is the largest segment of the state's mineral industry. Environmental issues and new corporate joint ventures affected the phosphate industry, which had a good year overall. Construction materials such as sand and gravel and decorative stone were in heavy demand.

Like gold mines worldwide, Idaho's few remaining gold operations also suffered from low prices.

Meridian Gold's Beartrack Mine in Lemhi County achieved a record production level in 1999. It poured 4.1 (32,725 oz) of gold last year and 5.4 t (173,370 oz) of silver from 4.6 Mt (5.1 million st) of ore during its final full year of production. That was a sizable increase from the 3.4 t (110,000 oz) of gold mined in 1998. The company announced earlier that the mine would close during the first quarter of 2000 due to reduced gold prices and consequent reduction of reserves.

Mining began in 1994 at the Beartrack heap leach, open-pit mine west of Salmon. Reclamation of the North Pit was nearly complete at the end of 1999 and mining was centered in the South and the Mason-Dixon pits. About 125 employees work at the operation, which is the largest employer in the area.

The Kinross DeLamar Mine in Owyhee County stopped mining and milling at the end of 1998. This happened when ores at the DeLamar pits were exhausted and production at the nearby Stone Cabin Mine was halted due to low metal prices. The property was on a care and maintenance status in 1999 with only 13 people left on site. Reclamation work in 1999 at the Stone Cabin included resloping, topsoil addition and reseeding of the Jacobs Gulch waste dump, backfilling and reclamation of the Tip Top pit and reclaiming the upper Tip Top haul road. The DeLamar Mill remained on standby status. Closure of the mine and the loss of 150 jobs was an economic blow to the sparsely populated ranching country.

US Antimony was in the process of closing its small flowjacket gold-copper mine in southern Lemhi county. The open pit was backfilled with tailings from the mill.

Reclamation and closure activities also continued at Pegasus Gold's Black Pine Mine in Cassia County, at

Hecla's Grouse Creek Mine in Custer County and at the Stibnite Mine in Valley County. Reclamation of bankrupt Dakota Mining's Stibnite gold mine and the Bradley Mill tailings site was under way by the state of Idaho, the US Forest Service and Mobil Oil. The Bradley Mill tailings occupy some 32 hm² (80 acres) of the Meadow Creek drainage at Stibnite. These tailings have been a long-standing and difficult environmental problem in the district. Mobil Oil and its contractors, Woodward-Clyde and Nelson Construction, were awarded Idaho Land Board reclamation awards in December 1999 for their successful efforts to stabilize the Bradley tailings and restore the Meadow Creek channel and fish habitat.

Thompson Creek Mining's molybdenum mine in Custer County continued to operate, though molybdenum prices were low. The open pit mine employs about 170 people and moves about 56 kt/d (60,000 stpd) of ore and waste. In addition to a standard flotation mill, the operation includes a plant that produces high-performance, lubricant-grade molybdenite.

In 1999, Thompson Creek Mining completed a supplemental environmental impact statement that was needed to operate its pyrite reduction plant. This plant removes pyrite from the tailings used to build the tailings impoundment. Due to delays in receiving biological opinions from federal wildlife agencies, the US Forest Service has issued interim Records of Decision. This allowed the company to operate the reduction plant. The company's preferred alternative is to isolate the pyritic tails by subaqueous deposition in the tailings pond.

Coeur d'Alene district

North Idaho's Silver Valley is one of the world's most productive silver districts, with more than 31.1 kt (1 billion oz) of silver produced since 1884 from high-grade vein systems. Production in 1999 was down slightly from 1998. About 404.3 t (13 million oz) of silver were produced last year compared with 416.7 t (13.4 million oz) in 1998. Substantial amounts of lead, zinc and copper are also extracted from the galena and tetrahedrite-rich veins in folded and faulted Proterozoic-age metasediments.

Unfortunately, lower (by about 25 cents) silver and base metal prices cut into revenues at Idaho's three operating silver mines — Sunshine Mining's Sunshine Mine, Hecla's Lucky Friday Mine and Silver Valley Resources' Galena Mine. The Coeur Mine, another Silver Valley Resources property, did not operate.

Silver Valley Resources began 1999 as a joint venture between Asarco and Coeur d'Alene Mines. But on Sept. 9, 1999, Coeur completed its acquisition of certain silver properties and assets from Asarco in exchange for 7.125 million shares of Coeur d'Alene common stock. The properties included Asarco's 50% interest in Silver Valley Resources. This gave Coeur d'Alene 100% ownership of the company that includes the Galena and Coeur

mines and additional property in the Silver Valley. Coeur also received several South American silver properties in the deal.

Production in 1999 at the Galena Mine totaled 105.7 t (3.4 million oz) of silver, plus lead and copper from 182 kt (201,000 st) of ore on three veins. Coeur continued an aggressive exploration program that drilled into a new discovery, the high-grade 117 vein. This vein was being developed on the 4300, 4000 and 3400 levels. The mine is also working on the 5500 level to access the newly discovered 72 vein. Ground control and shaft problems increased costs and cut production at the Galena Mine.

In early 1999, Sunshine Mining announced new discoveries in the West Chance area of the Sunshine Mine at Kellogg. These discoveries partially alleviated the \$50-million writedown the company took in late 1998.

Sunshine also started work on a major exploration project, a ramp eastward from the Sunshine Mine to the Con Silver shaft. But finances shut down the project temporarily in November with the heading some 396 m (1,300 ft) east of the Sunshine workings. The ramp would enable access to and exploration of an untested area of "elephant country." The Sunshine Mine produced about 161.7 t (5.2 million oz) of silver in 1999. This was a decrease from the 180.4 t (5.8 million oz) in 1998.

Hecla Mining's Lucky Friday Mine in Mullan obtained ore from the original Lucky Friday vein on the 5840 level and the newer Gold Hunter ore body, connected by a 1.6-km- (1-mile-) long haulage tunnel to the

Silver Shaft. Mining of the Gold Hunter discovery began in mid-1997. It involves underhand and overhand cut-and-fill stopes connected to ramps. Total production from the Lucky Friday Mine in 1999 was 136.8 t (4.4 million oz) of silver and 25 kt (27,613 st) of lead. This was an increase from the 127.5 t (4.1 million oz) of silver mined in 1998. About 86% of the production came from the Gold Hunter side. About 200 people work at the mine.

Reclamation of the Bunker Hill Superfund site is nearly completed. About \$100 million has been spent to date. A major issue is the call by the Tribes and others to expand the Superfund designation to the entire Coeur d'Alene River basin. This would be a mammoth undertaking. Smaller cleanup efforts by Silver Valley Trustees and the US Forest Service and the US Bureau of Land Management have been effective in the Canyon Creek and Ninemile Creek areas.

This historic mining area is of great interest to many people. Each year, 20,000 tourists seek out tours of the Sierra Silver Mine in Wallace to see how mining is done deep underground in the Silver Valley. Another mine tour opened at the Crystal Gold Mine near Kellogg.

In other news, J.R. Clarkson, chairman of The Clarkson Co., received an honorary doctorate from the University of Idaho for his revolutionary mineral processing inventions, such as the reagent feeders in use at mills in the Silver Valley.

Other north Idaho

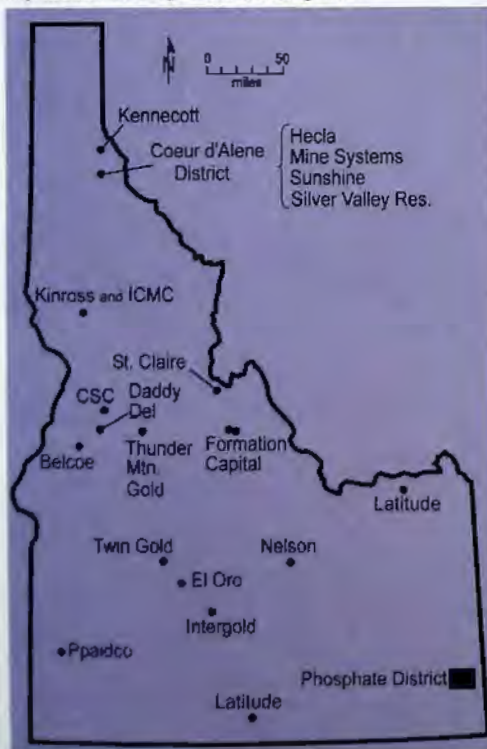
Exploration in Idaho (Fig. 1) was negatively impacted by the low precious- and base-metal prices. The number and size of grass roots and advanced projects were down significantly from 1998 and much below levels of five years ago.

The area near Elk City in Idaho County is one of Idaho's major historic gold-producing regions. Idaho Consolidated Metals of Lewiston continued to hold the Buffalo Gulch property near Elk City. Results from last year's induced-polarization resistivity work indicated several untested targets at this heap leachable gold deposit exposed at the surface. The main ore body was drilled and permitted by Bema in the early 1990s but never brought into production.

At the nearby Petsite joint venture with Kinross Gold, ICMC reported final results from the 1998 drilling, where two of the best holes were drilled at the very end of the 1998 program. Petsite is located along the Orogrande Shear Zone. It has geochemical and geological features similar to the Fort Knox deposit near Fairbanks, AK. Drill results at Petsite show substantial widths of grades of more than 1.1 g/t (0.032 oz/st) with some higher grade intercepts along the shear. The zone is open to the north where thick intercepts of more than 1 ppm gold were intersected at the very end of the program. The delineated resource is about 18.6 t (600,000 oz) of gold, based on three-dimensional mine modeling software. The host rock is an altered mica schist that has been intruded by a felsic stock. Kinross was seeking a joint venture partner interested in the project.

The town of Murray north of the Coeur d'Alene district was the site of an early placer gold discovery in 1881, prior to the silver-lead discoveries that revealed the real treasure of the region. Kennecott drilled one core hole near Eagle Creek on its Niagra project near Murray. The company was looking for stratiform base-metal min-

Exploration activity in Idaho during 1999.



eralization in the Proterozoic Belt sediments. Though results of that single hole were disappointing, Kennecott plans to continue its reconnaissance work in the region.

New geologic mapping by the Idaho Geological Survey and the US Geological Survey in north Idaho may provide useful information to explorationists trying to unravel the rich mineralization in the Belt Basin.

Salmon area

Exploration near Salmon in Lemhi County was centered on the Blackbird district. Formation Capital continued work on the Sunshine project in the Idaho Cobalt Belt. Copper-cobalt-gold horizons represent Proterozoic exhalative mineralization laid down during deposition of the clastic Yellowjacket Formation. Formation Capital's claims, staked in 1994, comprise an 11.6-km² (2,874-acre) parcel surrounding the patented core of the district that includes Noranda's Blackbird Mine.

The Blackbird district is the only known domestic source of high-grade cobalt reserves. Formation Capital's efforts have included a districtwide reconnaissance program and delineation of 25 separate target zones and more than 100 diamond drill holes. The Ram zone, perhaps the most exciting discovery to date, was the object of the 1999 drilling. The company drilled 11 core holes, totaling 1,590 m (5,210 ft). The results extended the Ram ore horizon from 426 m (1,400 ft) to more than 716 m (2,350 ft) along strike and down dip. Hole R99-04 intersected a true width of 2.4 m (7.8 ft) grading 1.089% cobalt, 0.12% copper and 0.78 g/t (0.023 oz/st) gold starting at a depth of 99 m (326 ft). The deposit is open along strike and dip. Results were being incorporated into a prefeasibility study by Mine Development Associates (MDA) of Reno, NV. Results were encouraging and Formation Capital began baseline environmental monitoring during the fall.

The 1999 results, as determined by MDA, increased the proven and probable reserves on the Sunshine project to 1.4 Mt (1.55 million st) grading 0.695% cobalt, 0.54% copper and 0.7 g/t (0.02 oz/st) gold. Proven, probable and inferred reserves stand at 2.4 Mt (2.7 million st) of similar grade, located in the Sunshine Lode and the Ram Zone.

Formation Capital's wholly owned Cobalt project is forecast to produce 1.5 kt/a (1,650 st) of cobalt from an underground mine with a flotation mill producing a cobalt and copper concentrate. An off-site hydrometallurgical plant would be constructed to produce high-purity cobalt. Total capital costs have been reduced to about \$46 million. The project has a net present value of more than \$135 million, with an internal rate of return of 44% to 69% at a cobalt price of \$16/lb.

West central Idaho

Thunder Mountain Gold announced plans to open the Thunder Mountain Mine at the site of the old Dewey Mine east of Yellow Pine in the central Idaho wilderness. Thunder Mountain is the owner of the patented claims at the property. At one time, USMX drilled a 9.3-t (300,000-oz) gold reserve before buying out Dakota Mining, which later went bankrupt. SAIC is doing the environmental impact statement for the new mine that would use the flat ridge top as a processing site.

At Warren, CSC Mining continued development of the underground Rescue Mine. This is a small, high-

grade gold operation. The company started another down ramp, built a new tailings pond and mined and stockpiled ore during the winter months. If gold prices improve, CSC Mining plans to run the gravity mill during the summer.

There has been renewed interest in placer mining in Idaho, both for gold and for gemstones. Terry Belcoe was working a gemstone placer on No Name Creek west of McCall near Brundage Mountain road. Sapphires are found in cemented gravel lenses, accessible by trenching.

The Daddy Del project explored for placer gold and zircons along the South Fork of the Salmon River near its confluence with the Secesh River northeast of McCall. Operators dug 13 backhoe holes for bulk sampling during the summer. The gravel of interest is most likely an old terrace gravel, rather than a deposit of the current channel. More work is planned.

East central and south central Idaho

There were several dormant precious metal projects in central Idaho during 1999. Twin Gold continued to hold the Atlanta project near Atlanta in Elmore County. Twin Gold diluted Quest USA's interest in the project and renegotiated a lease agreement with Monarch Greenback. The drilled out resource is 20 Mt (22.1 million st) grading 2.1 g/t (0.06 oz/st), totaling 42.6 t (1.37 million oz) of gold.

Intergold gets the Oscar for the most disturbing, if melodramatic, exploration saga of 1999. The story concerned the company's Blackhawk property a few miles north of Shoshone in Lincoln County. The company had reported a discovery of gold mineralization in unaltered Pliocene Moonstone rhyolite. However, normal fire assays could not recover the gold.

Intergold and Auric Labs of Salt Lake City, UT had developed an assay procedure that produced some flashy results from the 1998 diamond drilling. Intergold's press releases reported an average of 2.6 g/t (0.075 oz/st) gold from 1,220 m (4,000 ft) of drilling, with mineralization fairly consistent to 152 m (500 ft) in depth over a wide area of unaltered rhyolite.

Intergold hired Dames and Moore to verify and validate the analytical work and assist Auric in converting its proprietary procedures to a production-scale laboratory. In June, Intergold announced a 1999 drill program of 60 reverse-circulation holes under Dames and Moore's chain of custody. That program was terminated after a few holes.

In September, Intergold started a series of core holes, also under the chain of custody supervision of Dames and Moore, whose reports had generally verified the Auric results, according to the press releases. But on Oct. 1, 1999, Intergold announced it was terminating the drilling and commencing legal proceedings in Utah against Dames and Moore and Auric Labs for breach of contract. The action shocked Dames and Moore, Auric and their personnel who were personally named in the \$10 million lawsuit.

The complaint alleged breach of contract and other charges, apparently because Dames and Moore was not successful in transferring the technology to a third independent lab. Late in 1999, Intergold hired Strathcona Mineral Services, a well-known Canadian mining consultant, to audit the analytical procedures and assays.

Few were surprised when, according to a Jan. 26, 2000

press release, Strathcona reported "that both laboratories could not find gold above the minimum detection limits in the samples, and concluded that based on the samples provided, gold and silver are not present in economic quantities in the rhyolitic lavas on the property." Strathcona's negative results were identical to results from three surface samples collected by the Idaho Geological Survey in 1998.

Industrial minerals

Phosphate rock from the Phosphoria Formation in Caribou County in southeastern Idaho is the state's most valuable mineral commodity. Idaho is the nation's only producer of elemental phosphorus, which is used in detergents, herbicides and food additives.

Four large mines extracted more than 6.2 Mt (6.8 million st) of crude ore in 1999. It was a good year, although environmental concerns related to selenium were impacting permits for new mine plans.

Simplot's Smoky Canyon Mine was the largest phosphate rock producer, with 2.3 Mt (2.5 million st) of ore taken from the E panel south of Sage Creek. Simplot generates a slurry that is piped to its phosphoric acid fertilizer plant in Pocatello. The company drilled more than 80 reverse-circulation holes for exploration. And it did additional work to address selenium and waste disposal issues for the next mine panels to the north.

Agrium operates the Rasmussen Ridge Mine, acquired from Rhone-Poulenc in 1997. The company's 910 kt (1 million st) of ore went to the Agrium fertilizer plant at Conda.

Solutia, formerly Monsanto, was mining the south end of its Enoch Valley Mine and planning selenium mitigation for the new South Rasmussen mine plan. Solutia's 1.2 Mt (1.3 million st) of ore goes to its elemental phosphorus plant in Soda Springs. The company completed a new tunnel under the highway and a 520-m (1,700-ft) overland conveyor. This enables ore trucks to unload without having to cross the busy highway.

FMC was mining the B pit at its Dry Valley Mine. The company was also revising reclamation methods to better limit selenium mobilization from waste dumps. FMC's ore goes by train to its elemental phosphorus plant in Pocatello, the largest of its kind in the world. The plant was working on reducing dust emissions and other environmental controls as per an agreement with the US Environmental Protection Agency.

Phosphate mines and plants employ more than 2,000 people in southeastern Idaho.

In corporate news, FMC and Solutia announced a marketing joint venture to be called Astaris LLC. In October, FMC and Agrium, with subsidiary NuWest Industries, announced plans to build a \$90-million purified phosphoric acid plant at Conda. The new plant would be built by FMC and operated by Agrium. It will produce industrial grade phosphoric acid. Completion is expected in mid-2001. New environmental upgrades will also benefit the existing Agrium plant.

Other industrial mineral operations had a good year. Demand was especially high for sand and gravel, cement and decorative stone, all used by the booming construction industry. Idaho produced aggregate worth an estimated \$46 million in 1998, according to the US Geological Survey.

Ash Grove Cement had another record year. It shipped 245 kt (270,000 st) of clinker from its plant at Inkom. L and W Stone operated the Three Rivers quarry near Clayton in central Idaho. The company expanded the pits and built a new haul road to increase production by 30% to 13.6 kt (15,000 st) in 1999.

Three companies quarry Oakley stone, a durable micaceous quartzite, for dimension stone in Cassia County. Teague Mineral Products reported good sales of Idaho zeolite from its CH pit in Owyhee County. The clinoptilolite can be used as a cation exchange filter and radionuclide treatment, as well as for odor control and soil amendments.

Carco mined bentonite from the BenJel Mine in Owyhee County. Idaho Travertine quarried and cut granite for the new LDS Assembly building in Salt Lake City, UT. The company is nearing the end of the complex, multiyear job. It required thousands of custom and sized pieces of granite processed in its stone cutting plant at Idaho Falls.

Hess Pumice in Malad mines and crushes pumice for lightweight aggregate and an ultrafine and pure powder used for polishing television screens. Markets improved in 1999. In June, Hess purchased for \$3.5 million the Malad perlite operation from Idaho Minerals. The new company was named Idaho Minerals. Hess performed needed maintenance on the expander plant in Malad and opened a new perlite pit.

In north Idaho, Emerald Creek Garnet had a slow year but was in the process of permitting a major expansion. The producer of placer industrial garnets won an Idaho Land Board reclamation award for reclaiming the floodplain and wetlands at the confluence of the east and west forks of Emerald Creek. ■

INDIANA

K.R. SHAFFER, Indiana Geological Survey

Overall, 1999 was profitable for the Indiana mineral industries. Industrial minerals, valued at more than \$717 million, were produced in Indiana. This was a 3.8% increase from 1998 and an record high for the state.

According to preliminary US Mine Safety and Health Administration (MSHA) data, about 3,803 people were employed in the nonfuel sector during 1999. This was a 1.6% increase from 1998. This sector includes crushed stone, construction sand and gravel, industrial sand, dimension limestone, gypsum, common clay and shale, ball clay, processing lime, and producing masonry and portland cement.

Aggregates and other industrial minerals

Business was very good in the aggregates industry last year. More than \$700 million was committed to road construction and maintenance projects, more than in any previous year. About 62.2 Mt (68.6 million st) of crushed stone and 26.5 Mt (29.2 million st) of construction sand and gravel were produced in 1999, according to preliminary figures from the US Geological Survey (USG). These were 1% and 10.4% increases, respectively, from 1998.

Several new operations opened during the year to help meet the state's growing need for aggregate.