

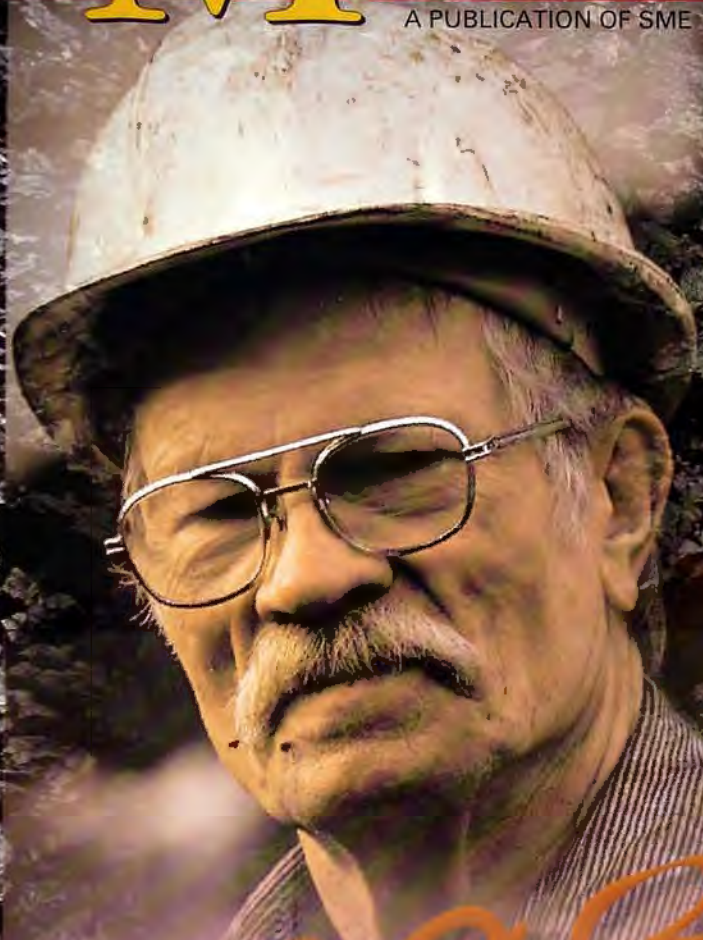


MAY 1999

Mining

ENGINEERING

A PUBLICATION OF SME



1998
Annual Review



Centex American Gypsum produced 372 kt (410,000 st) of gypsum in 1998 from its open-pit gypsum mine and plant in Gypsum. That is an 11% increase of from 1997's 335 kt (370,000 st). The company will complete a two-year production expansion program in 1999. The expansion will result in a capacity increase to 500 kt/a (550,000 stpy).

Exploration

Sunshine Mining and Refining is conducting prefeasibility studies of the high-grade silver deposit at the Revenue-Virginus Mine in Ouray County. The mine is estimated to contain 193 t (6.2 million oz) of silver in 237 kt (260,000 st) of ore. Grades are 823 g/t (24 oz/st) silver, 20.6 g/t (0.6 oz/st) gold and a combined 5.9% copper, lead and zinc.

Historically, the Virginus vein contains some of the highest grade silver ore in the state, averaging about 4.3 kg/t (125 oz/st). Mineralogy and grades of the tetrahedrite-galena-quartz vein persist over 1,065 m (3,500 ft) of depth, based on exposures in the old mine workings and in drill core. During the summer of 1998, Sunshine rehabilitated the entry of the main adit. Sunshine plans more exploration drilling on its claims and a metallurgical testing program.

Royal Gold of Denver ended its exploration program for diamonds on the Union Pacific Resources land in the State Line district of Colorado and Wyoming. The company has no further plans to explore or develop prospects in this area. Royal Gold's agreement with Union

Pacific covered more than 202 km² (50,000 acres).

Summo USA had two sediment-hosted copper prospects in Colorado: the Cashin prospect in Montrose County and the Copper Spur prospect in southern Routt County. The company relinquished its claims at the Cashin prospect to focus on its Lisbon Valley copper project in Utah and the Johnson Camp in Arizona.

American Soda of Glenwood Springs announced plans for a nahcolite solution-mining project in the Piceance Basin in Rio Blanco County. The company plans to use a steam tunnel to convert the sodium bicarbonate from the nahcolite to sodium carbonate, or soda ash. American Soda plans to produce about 1.3 Mt/a (1.4 million stpy) of soda ash. The planned solution mine will be located near Meeker. A 67-km (42-mile) pipeline will transport the pregnant solution to a redesigned Unocal oil shale plant north of Parachute for processing and packaging.

In 1998, Calais Resources of British Columbia completed the purchase of the assets of Hendricks Mining Co. This is the Cross-Caribou mining project in the Grand Island district, Boulder County. The company has had a continuous exploration-drilling program during 1998. Some of the recent core holes have intercepted a new gold-bearing breccia zone that parallels the past productive No Name vein. Preliminary data indicate that the breccia zone may be up to several thousand feet long with widths up to 15 m (50 ft). Gold in the breccia zone is associated with iron, copper, lead and zinc sulfides, and one or more silver minerals. ■

IDAHO

BY MICHAEL GILLERMAN and E.H. BENNETT, Idaho Geological Survey

The Asian recession and the global downturn in metal prices during 1998 negatively effected mining and mineral exploration in Idaho. The number of exploration projects in the state decreased.

In addition, the Stibnite gold mine closed due to reserves exhaustion. And Kinross Gold announced at the end of the year that its DeLamar Mine in Owyhee County would close.

However, Idaho's silver mines, phosphate operations, and sand and gravel industry enjoyed some success. The southeast Idaho Phosphate Reserve, whose mines and processing plants combine for about \$500 million, was in full production for the year. Silver production in the Coeur d'Alene District of north Idaho increased significantly at Hecla Mining's Lucky Friday unit and Sunshine Mining and Refining's Sunshine Mine. Hecla also completed its Gold Hunter expansion project on time and on budget (ME, April, 1999, p. 17). Silver prices averaged more than 16 cents/g (\$5/oz) during 1998 but remained volatile and not up to expectations for the year.

Gold and molybdenum production decreased due to closures and price-induced cutbacks. The state's largest gold mine is Meridian Gold's Beartrack Mine in Lemhi County. In 1998, it produced more than 3.4 t (110,000 oz) of gold, slightly more than in 1997.

Kinross Gold's DeLamar and Stone Cabin mines in Owyhee County poured 1.2 t (39,247 oz) of gold and 39.8 t (1.28 million oz) of silver during 1998 from 1.16 Mt (12.8 million st) of ore. Low gold prices prompted the DeLamar Mine's premature closure, kept several small operations shut down and severely cut back interest in gold exploration.

Gold's price drop also forced Meridian to re-evaluate reserves at the Beartrack Mine and shortened its life to just another two years. Beartrack is a heap-leach, open-pit gold mine near the old placer mining ghost town of Leesburg. Meridian expanded the leach pad, focused production on the South Pit and commenced backfilling of the North Pit.

Low gold prices also kept the mill mothballed at CSC Mining's small, underground Rescue gold mine near Warren. However, crews continued development work during the winter. A similar situation existed at US Antimony's Yellowjacket Mine in Lemhi County.

Reclamation

The 1997 closure of three precious metal mines meant major reclamation work in 1998. Despite declaring bankruptcy, Pegasus Gold continued work at the Black Pine Mine in Cassia County of south central Idaho. In central Idaho, Hecla Mining continued recontouring and reclaiming the waste dumps and dewatering the tailings pond at its Grouse Creek Mine in Custer County.

At the closed Stibnite Mine in Valley County, clean-up of the processing plants was taken over by the state after Dakota Mining forfeited its \$800,000 reclamation bond on the heap-leach gold mine. In addition, Mobil Oil stepped in to finance and direct work on the remediation of the historic Meadow Creek tailings area, on behalf of Superior Oil, which operated Stibnite from 1982-1985.

A decline in molybdenum prices throughout 1998 hurt Thompson Creek Mining's Thompson Creek open-

Exploration activity in Idaho during 1998.



pit mine in Custer County. Mining for a phase four pushback began in April. However, by October the price drop forced a 25% production cut and layoffs of 75 workers at the mine. A supplemental environmental impact statement (EIS) on handling of the pyritic mill tails was completed in the late summer but the US Forest Service decision was not scheduled until 1999. Subaqueous deposition is the preferred alternative.

Coeur d'Alene District

Silver production in the Silver Valley during 1998 increased to more than 342 t (11 million oz) vs. 298.5 t (9.6 million oz) in 1997. The increase resulted from past exploration success at Sunshine Mining's Sunshine Mine, Hecla's Lucky Friday Mine and Silver Valley Resources' Galena Mine. All of these are underground operations. Silver Valley Resources' Coeur Mine was placed on standby in July but exploration continued. Silver Valley Resources is a joint venture of Asarco and Coeur d'Alene Mines.

Sunshine Mining and Refining had mixed news from its famous Sunshine Mine. Total output increased to more than 180 t (5.8 million oz) of silver in 1998, up from 130.6 t (4.2 million oz) in 1997. Production was primarily from the galena and tetrahedrite of the West Chance vein. An aggressive exploration drilling program delineated the apparent edge of the ore body and failed to expand the reserve base by end of 1998.

Hecla Mining completed the \$16-million development of its Gold Hunter ore body and expansion of the Lucky Friday Mine at Mullan. The higher grade ore helped to double the silver production from the Lucky Friday unit to 127.5 t (4.1 million oz) in 1998. Total costs also decreased as a result of the higher grade. The 4900 level of the Gold Hunter deposit is connected by a 1,500-m (5,000-ft) haulage level to the Lucky Friday Silver Shaft. By year's end, most production was from the Gold Hunter side of the mine and reserves were 622 t (20 million oz).

Other north Idaho

The region near Elk City in Idaho County is a historic gold-producing area and the scene of some of the liveliest exploration in 1998. Idaho Consolidated Metals (ICM) holds the Buffalo Gulch gold deposit northwest of Elk City. The deposit was drilled and permitted by Bema several years ago but never brought into production. The deposit is marked by a silicified and quartz-veined intrusive. ICM did a regional soil-sampling program and delineated a 3,960-m- (13,000-ft-) long anomaly on the Burpee property near Dixie.

Further south, along the Orogrande Shear Zone, Kinross Gold continued the work begun two years ago by Cyprus Amax on the Petsite project at Orogrande in Idaho County. Petsite is a joint venture with ICM. Work in 1998 included 100 dominantly reverse-circulation drill holes. Drilling showed several intervals of low grade and some intriguing intercepts of visible gold. Kinross followed up in 1998 with a dozen diamond drill holes (PC16-PC21), totaling 2,200 m (7,200 ft) of core, to better define the Friday deposit at the Petsite property. The target is high-grade gold in the wide zones of low-grade mineralization in the shear zone. One hole returned 60 m (200 ft) grading 1.16 g/t (0.03 oz/st) with several intercepts of more than 3 g/t (0.088 oz/st).

Salmon area

Meridian Gold continued full production at the Beartrack Mine. But lower metal prices forced a major re-evaluation and a reduction in reserves. Backfilling of the mined out North Pit and waste rock characterization work continued as the main production shifted to the South Pit. Proven and probable reserves at the end of 1998 were 5.7 Mt (6.3 million st) of ore grading 1.5 g/t (0.044 oz/st) gold for 8.83 t (284,000 contained oz). Exploration drilling was limited to the mine area. Claim blocks were reduced at the nearby Arnett Creek gold project and the Humbug, or Ditch Creek, property to the north.

Formation Capital continued work on the Sunshine project in the Idaho cobalt belt of Lemhi County. Copper-cobalt-gold ore is hosted in exhalative horizons of the Proterozoic Yellowjacket Formation. Through unpatented claims staked in 1994, Formation Capital owns 100% of the Sunshine project in the Blackbird Mining District. This is the only known domestic resource of high grade cobalt. Formation's claims surround a patented core that includes Noranda's Blackbird deposit (5.9 Mt or 5.4 million st of 0.71% cobalt and 1.2% copper).

Since 1994, Formation has conducted a districtwide, grassroots soil geochemistry and exploration program. The company has also completed 111 diamond drill

holes totaling 19,760 m (64,500 ft). Twenty-five targets have been identified but only four have been drilled, including the Sunshine, East Sunshine and RAM zones. Drilling in 1997 of 18 core holes on the RAM target intersected a major new discovery. It may be the strike continuation of the main Blackbird Mine series.

Work in 1998 focused on a prefeasibility study by Mine Development Associates (MDA) of Reno, NV. The MDA study calculated 884.2 kt (974,700 st) of proven and probable reserves grading 0.6% cobalt, 0.525% copper and 0.6 g/t (0.017 oz/st) gold, plus 1.3 Mt (1.4 million st) inferred (at a cobalt price of \$20/pound).

The mine plan calls for underground cut-and-fill mining with flotation of cobalt and copper concentrates and an offsite hydrometallurgical facility to process the cobalt. The MDA report showed an attractive economic return for the project. Additional drilling is planned when financing can be arranged. The project has potential for increased tonnage because many targets have not been evaluated.

West-central Idaho

The Dewey gold deposit in the Thunder Mountain District was in the permitting process during 1998 when Dakota Mining defaulted on its obligations. Nelson Construction of Boise has taken over the Dewey project and is proceeding with the environmental impact statement (EIS). The previously indicated resource is 4.8 Mt (5.3 million st) averaging 1.7 g/t (0.05 oz/st) gold. Monitoring work continued for the EIS but no additional exploration was done.

East-central and South-central Idaho

Cambior Exploration was attempting to sell its interest in the Sultana copper-gold project near Mackay in Custer County. Cambior drilled 47 core holes into the copper-gold skarn from 1995 to 1997, delineating a 17-Mt (19-million st) resource.

Twin Gold announced the results of a scoping study on the Atlanta Gold project near Atlanta in Elmore County. The prefeasibility study noted positive results for continuing work on the property that hosts reserves that could reach 31.1 t (1 million oz) of gold and 99.5 t (3.2 million oz) of silver. A likely mining scenario at Atlanta Gold is based on 23.4 t (754,000 oz) of gold and a seven-year, open-pit mine life at \$10.45/g (\$325/oz) gold.

Latitude Minerals, of Vancouver, drilled 10 holes at the Blue Hill Creek property near the Utah border in Cassia County, south of Oakley. The area was explored and drilled previously by Meridian and Westgold, which completed 23 holes from 1986 to 1989. Silicification and precious-metal mineralization in the Tertiary volcanics is probably hot-spring related. Latitude was also attempting to test the Paleozoic rocks underlying the volcanics. One hole that penetrated through the cover rocks produced some interesting results.

Intergold controls more than 900 claims on the edge of the Snake River Plain, north of Shoshone. The claim block, known as the Blackhawk project, is underlain by unaltered rhyolite mapped as part of the Pliocene Moonstone Rhyolite unit. There is no record of historic metal mining in the area. The area was first staked and drilled by Mindoro Gold several years ago.

Intergold drilled nine core holes to 150 m (500 ft) in 1998. Intergold reported that most of the holes inter-

sected significant gold mineralization. Averages were 3.1 g/t (0.09 oz/st) gold and 6.5 g/t (0.19 oz/st) silver in 1.5-m (5-ft) intervals every 15 m (50 ft) of depth from surface to 150 m (500 ft), similar to reported outcrop values. However, standard fire-assay techniques do not consistently reproduce these results.

Southwest and Southeast Idaho

Latitude Minerals optioned the Kilgore project in eastern Idaho's Clark County. Echo Bay Mines and other major companies completed several summers of drilling on the volcanic-hosted, epithermal precious metal target. Latitude's work included six reverse-circulation holes on the backside of the mountain. The goal was to enlarge the size of the resource drilled by Echo Bay.

Nelson Construction of Boise started a small, grass roots exploration effort. The company picked up the Hub Mine near Martin in Butte County and conducted surface geological and geochemical work.

Industrial minerals

Phosphate mining and processing is the largest mineral industry in Idaho. The Phosphoria Formation supplies ore for four major mines in Caribou County in southeastern Idaho. Production levels increased slightly to about 6.1 Mt (6.7 million st) of ore. Market demand for phosphate fertilizer and other products remained good, though prices were starting to drop due to the slump in Asian markets.

Boise-based J.R. Simplot's Smoky Canyon Mine near the Idaho-Wyoming border is the largest phosphate producer with nearly 2.3 Mt (2.5 million st) extracted. The mine had increased output to accommodate a planned expansion of Simplot's phosphoric acid fertilizer plant, located in Pocatello. Smoky Canyon ore is sent to the plant through an 140-km- (87-mile-) long slurry line. Simplot also did exploration drilling on its Deer Creek lease and won a state reclamation award for past exploration projects.

Agrium, a Canadian agribusiness, operates a fertilizer plant at Conda, north of Soda Springs. The plant employs 285 people and had another record year. In January, Agrium finalized acquisition of Rhone-Poulenc's Rasmussen Ridge Mine. In March, Agrium hired MK Mining as contract miners. Main production is from the Central Pit and stripping and production also began from the North Pit. All of the ore goes to the plant at Conda.

Solutia, formerly Monsanto, operates the Enoch Valley Mine and an elemental phosphorus plant at Soda Springs. The plant also had a record year. A \$2-million safety project was started to relocate the ore unloading station to the east side of the highway and to install a 610-m- (2,000-ft-) long conveyor belt in a culvert under the road. This will eliminate the large ore trucks needing to cross the highway next to the plant.

Slag from Solutia's phosphorus plant is used by Kerr-McGee's vanadium plant across the road to produce vanadium pentoxide, used by the steel industry. In June, Kerr-McGee started up a single phosphate fertilizer plant to help use up the vanadium tailings, which run some 14% phosphate.

FMC was mining from the B Pit at the Dry Valley Mine and permitting the C and D pits. The company

won Idaho Land Board reclamation awards for both its quartzite quarry and the Dry Valley Mine A Pit reclamation work. FMC operates the world's largest elemental phosphorus plant at Pocatello.

FMC also reached a consent agreement with the US Environmental Protection Agency in October for a \$190-million program to reduce air- and other pollution at the plant. Projects include pond remediation, waste treatment, air quality improvements and health studies for the Shoshone-Bannock tribe, as the plant is on the Fort Hall Reservation. FMC also plans to rebuild one of the four electric furnaces.

Strong demand for construction sand and gravel continued, particularly in urban areas. Idaho and other western states are experiencing rising population growth and development. There has been a steady demand for and production of dimension stone and landscaping rock.

Hecla's Mountain West Bark merged with Colorado Aggregate to form MWCA, based in Rexburg. The new

company produces red and gold pumice for landscaping. Sales of the unusual gold-colored pumice were up last year.

Some industrial commodities were affected by the economic slowdown overseas. In north Idaho, Emerald Creek Garnet saw sales of its industrial garnets, used for abrasives and water jets, slow slightly. The company has plans to expand operations to a 168-hm² (416-acre) parcel near the St. Maries River, adjacent to current leases. The project will require an EIS and a 404 permit.

Hess Pumice in southeastern Idaho sells fine, ultrapure pumice for polishing television screens. Sales to the Pacific Rim countries were down. Hess is collaborating on a new product, a special microgrout cement that is more stable chemically and can penetrate finer cracks.

Also in southeastern Idaho at Inkom, Ash Grove Cement had another record year, shipping 245 kt (270,000 st) of clinker. Ash Grove is Idaho's only cement operation. ■

INDIANA

K. R. SHAFFER, Indiana Geological Survey

The US Geological Survey estimates the value of Indiana's nonfuel production at \$698 million during 1998. This was a 4.3% increase from 1997 and a record for the state. Indiana ranked 21st nationally in the value of its industrial mineral production. All commodities, except for dimension stone, showed moderate increases in production. About 3,744 people were employed in the Indiana nonfuel industry during 1998, according to preliminary figures released by the US Mine Safety and Health Administration (MSHA).

About 60.8 Mt (67 million st) of crushed stone were produced, an increase of 3.1% from the previous year and another state record. Indiana ranked 12th nationally in crushed stone production.

A joint venture was begun between Tom Miller Quarries and Litter's Quarry of Indiana at an underground crushed stone mine in Scott County. Mulzer Crushed Stone opened a new quarry between New Amsterdam and Mauckport in Harrison County. Other significant openings included Stoneco's Milner Quarry in Miami County, Junction Limestone's Uland Quarry in Greene County and Innovative Crushing and Aggregates quarry in Clark County. The Uland Quarry is a surface operation that may eventually go underground if the market is favorable.

Sand and gravel

Sand and gravel production showed a gain of 7.8% in 1998 from 1997 with 23.6 Mt (26 million st) produced, ranking the state 14th nationally. Bethlehem Sand and Gravel will begin mining on 1 km² (250 acres) along the Ohio River in Clark County. Martin Marietta opened its plant at Kokomo, Howard County, that was in development last year. Other openings include Irving Gravel's Angola Pit in Steuben County, Elkhart County Gravel's Middlebury Plant 2 in Elkhart County; Krafft Gravel's operation in Allen County, Harco Sand and Gravel's operation in Marion County and Purdy Materials' Plant No. 1 in Tippecanoe County. Hunt Lake Pit, a Rieth-Riley Construction operation located in LaPorte County, closed during the year.

The aggregate industry is anticipating a surge in business with the passage of the Transportation Equity Act for the 21st Century. This will provide \$3.7 billion in federal funds for highways for six years.

The Indiana Mineral Aggregates Association worked with other industry groups and MSHA to develop training regulations for noncoal, nonmetal mines. The group also worked to develop self-regulation for reclamation of aggregate pits and quarries.

Dimension stone and limestone

About 174 kt (192,000 st) of dimension limestone were produced in Indiana during 1998. This was an 8.2% decrease from the previous year. Indiana ranked first nationally in dimension stone production.

Despite a small decrease in overall production, companies report that they had a very good year with production at near capacity.

Indiana limestone was sent to Iowa for repairs to the state capital building and to Chicago, IL for school construction. It was used for federal courthouse projects in Sacramento, CA, Fargo, ND and Tallahassee, FL. And Indiana limestone will be sent to Washington DC for the Pope John Paul Cultural Center.

The Indiana Limestone Co. supplied stone from one of its P.M. and B. quarries for major renovations to the Empire State Building. The quarry provided the original stone for the building.

No new dimension limestone quarries were opened during the year. However, Mansfield Stone opened a dimension sandstone quarry at the site of an old quarry in Parke County.

Other industrial minerals

About 966 kt (1.1 million st) of common clay was produced in the state, ranking the state ninth nationally. In addition, gypsum, industrial sand and gravel, miscellaneous stone and peat were mined during the year. Indiana ranked seventh in crude gypsum and peat production during 1998.

The Indiana Geological Survey (IGS) continued re-