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Mining

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1996, but was reopened in January 1997 and returned to full production status.

Construction materials and industrial minerals

The sand, gravel and aggregate industry produced approximately 42.6 Mt (47 million st) of material in 1997, up slightly from the 41.7 Mt (46 million st) in 1996. The value of the 1997 production is estimated to be \$209 million. Continued residential building in Colorado, especially in the Front Range counties, is largely responsible for the growth in construction material production. Other construction and industrial minerals produced in the state during 1997 include peat, silica sand, bentonite clay, common clay and kaolin.

Colorado Yule Marble has been mining white marble from the historic Yule Marble Quarry near Marble. The company had some difficulties in 1997 and is undergoing a change of ownership.

Colorado Diamond, a subsidiary of Redaurum, began production in May 1996 at the Kelsey Lake Mine in the State Line district of Larimer County. It is North America's first large-scale, commercial diamond mine. The mine and processing plant are currently processing about 40 to 50 kt/month (44,000 to 55,000 st/month) of kimberlite ore. The plant produced about 9,000 carats in 1997. Currently, two kimberlite pipes are mined in the open-pit operation. The total acreage of the two ore bodies is about 9 hm² (22.2 acres). The stripping ratio is between 1.5:1 to 2:1. The total resource in the current mine plan is 16.9 Mt (18.6 million st) to a depth of 100 m (330 ft).

More than 60% of the diamonds recovered at Kelsey Lake are of gem quality. This includes a 28.3-carat light yellow diamond, the largest ever discovered in the State Line district and the fifth-largest found in North America. In 1997, the company recovered two large gem-quality stones: a 28.2-carat yellow diamond and a 16.3-carat white stone.

Redaurum acquired exclusive rights to the Maxwell kimberlite 2 km (1.2 miles) west of the Kelsey Lake Mine. Plans for 1997 included processing of a 10-kt (11,000-st) bulk sample.

Mining for gem-quality rhodochrosite crystals continued at the Sweet Home Mine near Alma, Park County. Production of rhodochrosite was down from 1996. The company plans to sink a winze in 1998.

Centex American Gypsum operated its open pit gypsum mine and plant in Gypsum, Eagle County in 1997 at a rate of 335 kt (370,000 st). The company is starting on a two-year project to increase the operation's production capacity to 544 kt/a (600,000 stpy).

White River Nahcolite produced about 70% of its plant's 113 kt/a (125,000 stpy) nameplate capacity of nahcolite, sodium bicarbonate, at its solution mine in the Piceance Basin, Rio Blanco County. The company produces food and industrial grade sodium bicarbonate (baking soda).

Exploration

The recent increase in silver prices has caused Sunshine Mining and Refining to reevaluate its Revenue-Virginus Mine in Ouray County. The mine is estimated to contain 192.8 t (6.2 million oz) of silver with an inferred resource of at least the same amount.

Historically, the Virginus vein contains some of the

highest grade silver ore in the state, averaging about 4,285 g/t (125 oz/st). Mineralogy and grades of the tetrahedrite-galena-quartz vein persist over 1,066 m (3,500 ft) of depth, based upon exposures in the old mine workings and in drill core. Sunshine will conduct prefeasibility studies on the Virginus vein this summer.

Anvil Resources acquired kimberlite prospects in the Chicken Park area of the State Line district. The company drilled 12 exploration holes on the property in 1996. Eleven of them encountered kimberlite. A large bulk sample is scheduled for the summer of 1998.

Royal Gold continued diamond exploration on the Union Pacific Resources land in the State Line district of Colorado and Wyoming. Royal Gold's agreement with Union Pacific covers more than 202 km² (50,000 acres) of land in the district. The company has also acquired some state leases, mining claims and mineral rights on private lands. In 1997, Royal Gold conducted a reverse-circulation drilling program in the district.

Summo USA has two sediment-hosted copper prospects in Colorado. These include the Cashin prospect in Montrose County and the Copper Spur prospect in southern Routt County. Some surface mapping and sampling were completed in 1997 on the Copper Spur prospect.

Since 1990, Teck Resources has been conducting an evaluation program of the White Earth project on the titanium resources of the Powderhorn district, Gunnison County. In 1997, Teck continued the second phase of pilot metallurgical tests. The pilot plant is expected to provide enough titanium dioxide for test pigment marketing purposes.

American Soda operated a pilot solution-mining project for nahcolite in the Piceance Basin near the White River Nahcolite Mine in Rio Blanco County. The company is using a special single-hole, solution-mining process developed by Shell Oil.

Hendricks Mining completed several core drill holes on its holdings in the Caribou district, Boulder County. Some of the core holes have intercepted new veins with high-grade gold and low-grade silver and base metals.

Tippecanoe Mining of Nevada is applying for a mining and reclamation permit for the Tippecanoe Mine in the Cumberland Basin area of the La Plata Mountains in southwestern Colorado. Earlier in this century, the Tippecanoe Mine produced small amounts of silver and even lesser amounts of gold. ■

IDAHO

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

For the first time in several years, Idaho's silver mines enjoyed a better year than the state's gold properties. By the end of 1997, silver prices were on the way up. However, gold and base metal prices were down, with the resulting toll on Idaho properties.

Gold production in Idaho during 1997 totaled 7.44 t (239,433 oz), a drop from the 1996 record of 10.8 t (347,470 oz). (Note: The US Geological Survey's 1996 Idaho gold production number reported in its statistical summary omitted the Beartrack production and is incorrect. The correct number, 10,801 kg, should be included in future *Minerals Yearbooks*.)

Like last year, Meridian Gold's Beartrack Mine was the top producer in 1997, with 3.3 t (107,271 oz) poured.

Pegasus Gold's Black Pine Mine extracted 1.37 t (44,081 oz) before its scheduled shutdown in December. Kinross Gold's DeLamar and Stone Cabin mines in Owyhee County produced 1.42 t (45,675 oz). Dakota Mining's Stibnite Mine accounted for 472 kg (15,168 oz).

Ore reserves were exhausted at Black Pine, which opened in 1991. Reclamation efforts were under way at year's end.

Hecla Mining's Grouse Creek operation in Custer County shut down in April due to errors in reserve calculations and disappointing production from the Sunbeam pit. Reclamation at Grouse Creek included pit recontouring and construction of a water treatment plant to prevent sediment from reaching the creek.

Thompson Creek Mining continued full operations at its Thompson Creek molybdenum mine in Custer County. In an innovative partnership, the company, along with local, state and federal agencies and fisheries groups, broke ground on a steelhead-rearing pond on Squaw Creek below the mine. The mine had a record year, turning out some 9 kt (20 million lbs) of concentrate and winning an Excellence in Annual Operations award from the Idaho Land Board.

Exploration efforts (Fig. 1) in the state were down. This was due largely to the softening metal prices. Industrial minerals and phosphate markets and operations were stable.

Coeur d'Alene district

Mines in the Coeur d'Alene District of north Idaho have produced more than 31.1 kt (1 billion oz) of silver since 1884. Investments in new technology, cost-cutting procedures and new geologic work during the past few years have resulted in new ore body discoveries and increased production at a time when silver prices are looking favorable.

Four deep underground mines extracted 300 t (9.64 million oz) of silver in 1997. This was a 56% increase from 1996's 189.7 t (6.1 million oz). These mines included Sunshine Mining's Sunshine Mine, Hecla's Lucky Friday Mine and Silver Valley Resources' Coeur and Galena mines.

Mining in the West Chance vein system in the Sunshine Mine increased silver production to 132.2 t (4.25 million oz) in 1997. That was the highest since 1990 and a 65% increase from 1996's 79.9 t (2.57 million oz). Cash costs decreased after the mine's successful conversion to diesel equipment and a ramp system a few years ago. Exploration of the new galena-rich West Chance vein is delineating a resource of more than 1.8 kt (60 million oz) of silver for Sunshine Mining and Refining. Grades at the West Chance are in the 685-g/t (20 oz/st) silver range.

Hecla Mining plans to spend \$16 million to develop the Gold Hunter ore body, located about 1.6 km (1 mile) north of the 4900 level of the Lucky Friday Mine. A development drift on the 5100 level was completed early in the year. More than 59 t (1.9 million oz) of silver were produced from the Lucky Friday in 1997. That may triple when the Gold Hunter comes on line. Ore grade at the Gold Hunter deposit is estimated at 617 g/t (18 oz/st) silver. The Lucky Friday Mill is being expanded to handle the extra production that should start in mid-1998.

Silver Valley Resources is a joint venture between Asarco and Coeur, The Precious Metals Co. Silver Val-

ley Resources operated the Coeur and Galena mines, which were restarted in 1996 after an extended closure. In May, the Galena reached full production of 545 t/d (600 stpd). Production from the two mines totaled 107.3 t (3.45 million oz) of silver. Exploration at the Galena is using a computer model to assist with compilation of the gigabytes of historical mine records. New vein discoveries include the 123 vein and 258 vein. Costs have been reduced to under 13 cents/g (\$4/oz). Some 200 workers are employed at the two properties. Silver Valley also obtained leases on several claim blocks near the Galena and Caladay properties.

The Bunker Hill Mine continued to extract pyromorphite crystals. These are in demand by mineral collectors. There was no metal production. But some refurbishing of the No. 2 hoist was done to allow access to the deeper levels.

Other north Idaho

Cyprus Amax put a major effort into exploring the Petsite project at Orogrande near Elk City in Idaho County. Petsite is a joint venture between Cyprus Amax and Idaho Consolidated Metals (ICM). Cyprus Amax drilled 90 reverse-circulation and 11 core holes on the property. Significant intercepts included PZ80 with 73 m (240 ft) of 1.6 g/t (0.047 oz/st) gold, including 27 m (90 ft) of 2.2 g/t (0.064 oz/st) gold. Core hole 10 also intersected visible gold. The drilled area is south of the historic Orogrande Frisco pit. Cyprus Amax also completed surface geological and geochemical work at the Deadwood property along the shear zone closer to Elk City and drilled 14 reverse-circulation holes. The company is evaluating the results.

ICM retained 100% control of the Buffalo Gulch properties, northwest of Elk City and north of the Deadwood property. A few years ago, Idaho Gold, a subsidiary of Bema Gold, delineated and permitted a heap-leachable deposit at Buffalo Gulch. It was never developed.

ICM drilled nine diamond drill holes at Buffalo Gulch in 1996. The results led to a reinterpretation of the geology. In 1997, ICM geologists completed a regional reconnaissance of the Elk City area. A stream sediment, rock chip and deep-soil geochemical survey was completed, as well as 38 line km (24 line miles) of IP-resistivity, looking for extensions of the shear zone in the heavily forested terrain. Results were encouraging and the company plans to do followup drilling during 1998.

Bear Creek Mining is a small, Washington-based holding company that purchased the name after Kennecott gave it up. The company acquired a lease on the Mary Kay (Black Pine) workings south of Elk City. It performed trenching and applied for permits to reopen the portal of the underground gold mine. The target is additional high grade veins as mined 60 years ago.

Salmon area

Meridian Gold's Beartrack Mine is located in Lemhi County near the historic site of Leesburg. The company expanded the leach pad to accommodate the 3.37-t (108,360-oz) extracted from 3.7 Mt (4.1 million st) of ore. The mine was recognized as one of the six safest mines in the nation by the US Mine Safety and Health Administration. Meridian and its environmental coordinator and

contractor also won a reclamation award from the Idaho Land Board for the Napias Creek wetlands restoration project. The company had an expanded exploration program that included about 40 drill holes in the mine area.

Meridian spent \$1 million to buy from Ashanti Gold-lds the Arnett Creek property southwest of Beartrack and the Ditch Creek property near North Fork. Arnett Creek was drilled several years ago by American Gold Resources. It hosts a resource of 11.8 t (380,000 oz) of gold. Ditch Creek (or Humbug) has a resource of more than 15.5 t (500,000 oz) of gold. Meridian drilled 11 core holes on the Haidee claims at Arnett Creek to confirm earlier reverse-circulation drilling.

Meridian also purchased the Musgrove property from Atlas Mining for \$200,000. It is located about 27 km (17 miles) southwest of the Beartrack Mine. Musgrove hosts an estimated 10.5 t (340,000 oz) of gold and was drilled by Atlas and Newmont. In 1997, the Beartrack crew drilled 13 reverse-circulation step out holes at Musgrove.

Formation Capital continued its effort on the Sunshine project near the Blackbird Mine in the Idaho cobalt belt of Lemhi County. Drilling focused on evaluating the Ram zone discovered in 1996 by soil geochemistry and mapping. The copper-cobalt-gold mineralization continued for more than 426 m (1,400 ft) along strike and 183 m (600 ft) down dip, with the zone open in both directions.

Work completed in 1997 at the Ram zone included 190 m (623 ft) of trenching and 20 diamond drill holes totaling 3,670 m (12,045 ft). Drill intercepts revealed multiple ore horizons. Assay results include R-97-12 with 4.3 m (14.1 ft) averaging 0.479% cobalt, 0.86% copper and 0.56 g/t (0.016 oz/st) gold. R-97-18 contained 3.6 m (11.8 ft) of 0.425% cobalt, 0.78% copper and 1.5 g/t (0.043 oz/st) gold. R-97-18 also contained 6.8 m (22.3 ft) of 0.594% cobalt, 0.89% copper and 0.45 g/t (0.014 oz/st) gold. The results are being evaluated and a new reserve calculation for this project is under way.

US Antimony went underground at the Yellowjacket Mine, reducing gold production as the company focused on development work in the sulfide ore. The historic district is 64 km (40 miles) southwest of Salmon. Gold-copper mineralization is hosted by breccias in the Proterozoic sediments.

BHP Minerals drilled four holes on the Blue Jay porphyry copper target in the Leadore District in southern Lemhi County. Though copper mineralization was encountered, the company reclaimed and returned the Lemhi Range property.

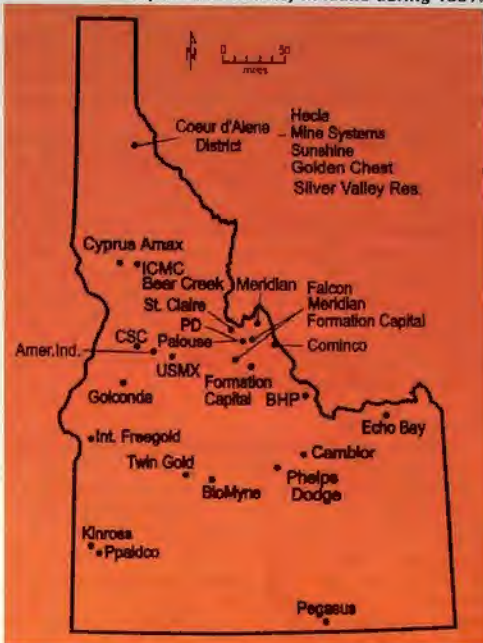
West central Idaho

Early in the year, Dakota Mining and USMX completed a merger. Dakota took over USMX's properties including the Dewey project in the Thunder Mountain Mining District, 32 km (20 miles) east of Dakota's Stibnite Mine. Dakota completed mining of the Stibnite pit and current reserves are depleted.

Permitting work continued for the Thunder Mountain Mine. It is expected to be the focus of Dakota's future production in the area. The company hopes to finish environmental impact statement on Thunder Mountain in 1998.

At Warren, CSC Mining expanded the settling pond and reconstructed a road at the Rescue Mine. Develop-

Exploration activity in Idaho during 1997.



ment work included 215 m (700 ft) of new drift and 60 m (200 ft) of raise on the high grade gold vein. Declining gold prices forestalled production in the latter half of the year.

East central and south central Idaho

Cambior Exploration's Sultana copper-gold project near Mackay in Custer County shut down in July after drilling eight additional core holes. During the 1995-1997 program, the company drilled 7,350 m (24,115 ft) in 47 core holes into the copper-gold skarn. The operator, Cambior, is a subsidiary of Cambior. It announced an increase in the geologic resource estimate to 17 Mt (18.7 million st) grading 0.49% copper, 0.19% zinc, 13.5 g/t (0.394 oz/st) silver and 0.48 g/t (0.014 oz/st) gold. An additional 9 Mt (9.9 million st) was also found of zinc-copper mineralization in the oxidized skarn. The company was evaluating its options at the end of 1997.

Bio-Myne won the 1996 reclamation award for exploration for its reclamation of drill roads in the West Fork Warm Springs Creek area. Bio-Myne explored for several years in the environmentally sensitive area west of Ketchum.

In February, Atlanta Gold and Voisey Bay Resources formed a new company, Twin Gold. It will include Atlanta's property in Elmore County along the Middle Fork of the Boise River. Historic production from the Talache Mine and other lodes in the district amounted to 12.4 t (400,000 oz) of gold and 28 t (900,000 oz) of silver.

In July, Twin Gold signed an agreement with Quest International Resources that gave Quest a 20% interest in the Atlanta property for its \$3.8-million investment in the mine area since 1993. Twin Gold is the operator and

is working on feasibility studies, permitting and seeking financing for additional exploration. Open-pit reserves are 33.6 t (1.08 million oz) of gold and 100 t (3.2 million oz) silver. An additional underground resource holds 7.4 t (240,120 oz) gold. Biooxidation is being considered for processing of refractory ore. Twin Gold also did some environmental sampling during the year.

On an adjacent parcel of land at Atlanta, a potential disaster occurred in May when a Talache tailings impoundment failed under melt water from the heavy snowpack. Floods washed an estimated 13,000 m³ (17,000 cu yd) of mill tailings down towards the river. However, most of the tailings were deposited on land. Under an agreement with the state, owner Monarch Greenback hired Terracon to characterize the site and implement corrective measures. A lower tailings impoundment structure was completed, several sediment basins constructed and best management practices installed to impede future erosion.

Southern Idaho

International Freegold completed a feasibility study in July for the Idaho-Almaden project east of Weiser in Washington County. Freegold acquired an interest in the property in May 1996, when it reached an agreement with Ican Minerals Ltd., Ican Minerals Inc. and Canu Resources. Idaho's largest mercury producer hosts 35 Mt (39 million st) of low-grade gold mineralization formed in a Tertiary hot springs system. The feasibility study was positive at the \$11.57/g (\$360/oz) gold price. It included comprehensive metallurgical testing. Future plans will depend on metal prices.

Echo Bay's Kilgore precious metal project was also inactive in 1997. Echo Bay did a major amount of work in 1995 and 1996, delineating a significant resource. But the company pulled the budget in 1997 and did a good job of reclaiming drill roads. The company is said to be interested in selling its interest.

Industrial minerals

Phosphate continued to be Idaho's largest mineral industry with more than \$600 million in processed mineral value in 1997. Idaho's four phosphate mines include FMC's Dry Valley Mine, Simplot's Smoky Canyon Mine, Rhone-Poulenc's Rasmussen Ridge Mine, and Solutia's Enoch Valley Mine. These operations mined more than 5.9 Mt (6.5 million st) of ore during the year.

Markets and production were good and there were several corporate changes. At midyear, Monsanto spun off its chemicals division and renamed it Solutia Inc. This included the phosphate operations.

FMC and Solutia operate elemental phosphorus plants, the only ones in the United States, at Pocatello and Soda Springs, respectively. The chemical is used in products ranging from Coca Cola to herbicides. FMC announced in October that it would invest \$73 million in new pollution-control equipment at the Pocatello plant.

Boise-based J.R. Simplot and Agrium, a Canadian agribusiness, operate fertilizer plants at Pocatello and Conda, respectively. Simplot acquired the assets and phosphate reserves of Alumet. Agrium announced plans to purchase the Rasmussen Ridge operation from Rhone-Poulenc. Rhone-Poulenc's mine had been supplying ore feed to the Agrium phosphoric acid fertilizer plant, which enjoyed a record year.

Exploration and permitting efforts for new phosphate mines were under way. However, a concern in the southeastern Idaho industry was selenium poisoning of horses that had eaten grass near an old mine dump. The selenium is naturally enriched in black shales of the Phosphoria Formation. Industry and state government personnel formed a selenium working group to study the complex problem and develop preventative measures.

Strong demand for construction sand and gravel continued, particularly in urban areas. This demand was fueled by Idaho's rapid population growth and development.

Idaho's most unique aggregate operation is G&B Redi-Mix's pit near Star. Located adjacent to the Boise River, the pit is actually a pond and gravel is extracted using a floating dredge. The marine operation is more environmentally friendly than a conventional pit.

Elsewhere, Ash Grove Cement had a good year, increasing production 10%. The quarry and plant is at Inkom. Near Oakley, the Rodriguez Oakley stone quarry reopened. Oakley Valley Stone and Northern Stone Supply also quarry the decorative micaceous quartzite. Golconda ended its diamond exploration project near McCall in Valley County. Bulk testing failed to find any diamonds, although indicator minerals were found. ■

ILLINOIS

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Mineral exploration activities in Illinois during 1997 remained low, as in 1996. Preliminary 1997 data from the US Geological Survey indicate that the production of crushed stone and construction sand and gravel creased. And the production of most other industrial minerals remained about the same. Coal production, however, declined for the third consecutive year.

Coal

Coal production dropped about 11%, from 42.6 Mt (47 million st) in 1996 to about 38 Mt (42 million st) in 1997. One reason for the decreasing demand for Illinois coal is the strong price competition by Powder River Basin low-sulfur coal. Another reason is that utilities are switching from medium- and high-sulfur Illinois coal to western low-sulfur coal, to comply with the Clean Air Act Amendments. However, the remaining mines had no difficulty selling their production. And most are running near full capacity.

More mine closures were announced, while expansions were completed or are planned at several mines. Kerr-McGee announced its intent to withdraw from the coal mining business. The company plans to sell its coal mining operations, including the Galatia Mine, currently the mine with the highest production in the state.

Monterey Mine No. 2, idle since mid-1996, was closed for good during 1997. Freeman-United's Orient No. 6 Mine was idled in March. The future of this 30-year old mine is uncertain.

Late in the year Zeigler Coal closed its Spartan Mine. And Consolidation Coal closed its Burning Star No. 4 Mine. The Spartan Mine had exhausted its reserves after 45 years of operation. Just a few years ago, these four mines produced about 7.2 Mt/a (8 million stpy) of coal.

On the positive side, Turris Coal increased its produc-