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ARIZONA MINING UPDATE - 1995

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As it has since 1988, Arizona continues to rank first in nonfuel mineral production in the nation. The value of mineral output in 1993 was $3.01 billion (see table, p. 2). Arizona also remains the leader in U.S. copper production, supplying 65% of the U.S. total. Arizona's 1993 copper production was 2.5 billion pounds valued at $2,309,340,000. Arizona leads or is among the leaders in the production of gemstones, molybdenum, silver, pyrite, and perlite. Excluding sand and gravel operations, there are 105 active mines in Arizona producing the above commodities plus additional metals and 18 varieties of industrial minerals. More than 14,000 people are directly employed by the mining industry.

COPPER

Rising copper prices, beginning in the spring of 1994 and continuing through the year, coupled with the expectation of a growth in demand by third world countries has had a stimulating effect on the copper industry. The price for cathode copper, averaging 88 cents in 1993, rose to $1.14 by the third quarter of 1994. The rise in copper prices is attributed to the general strength of the U.S. economy and the apparent signs of economic recovery in Europe. The absence of copper production from new deposits in 1994 was also a factor.

Arimetco Incorporated

Arimetco produces cathode copper from the Johnson Camp mine, while development continues at their Van Dyke and Zonia copper properties.

Johnson Camp, located 65 miles east of Tucson, produced 7.4 million pounds of copper in 1993, down from 8.2 million pounds in 1992. The unusually heavy rains during the first four months of 1993 diluted the solution grades coming off the heaps and entering the solvent extraction-electrowinning (SX-EW) plant. Reserves in the Burro Pit at Johnson Camp are estimated at 15 million tons, with Copper Chief reserves estimated at 9.6 million tons.

The Emerald Isle open pit mine near Kingman produced 576,000 pounds of copper in 1993 before operations were suspended in September, 1993. The mine currently is on care and maintenance. Arimetco reports that the rains in early 1993 forced suspension of shaft rehabilitation at the Van Dyke shaft at Miami. Future mining plans are to inject acid into previously mined underground areas and treat recovered solutions in an SX-EW plant. The company anticipates that the Van Dyke, subject to completion of environmental permitting and a feasibility study, will justify construction of a 50,000 per day SX-EW plant.

Premine-plan drilling was completed at Zonia near Kirkland Junction. Reserves totaling 47 million tons have been identified. Engineering efforts are underway for an open-pit mine and construction of an SX-EW plant. It is anticipated that final permits will be issued in 1995 and production may commence by late 1995.

Asarco Inc.

Asarco's Arizona operations consist of the Hayden copper smelter, two major open-pit mines, Mission and Ray, and a dump leaching/cementation operation at the Silver Bell mine. The mines' production was 333 million pounds of copper in 1993. The completed modernization of their facilities has boosted the output at Mission and Ray to equal the capacity of Asarco's smelters at Ray and El Paso. Asarco, along with joint venture partner Freeport, continues the in-situ leach research at the Santa Cruz property in cooperation with the U.S. Bureau of Mines. They received an Aquifer Protection Permit that will allow them to inject dilute sulfuric acid into the copper bearing formation. Asarco also holds major reserves at the Chilito north of Hayden, at Helvetia, east of the Mission Complex, and at Sacaton East.

The Hayden Smelter consists of an INCO flash furnace rated at 720,000 tons of charge per year for an estimated production of 175,000 tons of blister copper. An acid plant rated at 1,600 tons of sulfuric acid per day controls sulfur dioxide emissions.

The company's Mission Complex, 18 miles south of Tucson, is a consolidation of the Mission, Eisenhower, San Xavier South, and Pima open-pit mines. The smaller but separate San Xavier North pit is also included. Sulfide ore is treated at two mills, Mission and South. They have the capacity to process 63,000 tons of ore daily resulting in an annual capacity of 124,000 tons of copper in concentrates. Mission produced 236 million pounds of copper in 1993. In September, 1994 Asarco announced it will develop an underground mine at the Mission Complex. The underground operation will add about 28 million pounds of copper per year beginning in early 1996.

The Ray Mine consists of an open-pit mine, two mills - a concentrator at Hayden and a newly commissioned 30,000 ton per day concentrator at Ray, dump and heap leach operations, and a 40,000 ton per year SX-EW plant at Ray. Output from the new mill made Ray the second largest producer in the state in 1993 with 159,000 tons of copper. The new mill allowed lowering the cut-off grade to 0.3% copper which resulted in a doubling of the reserves to 1.1 billion tons. This puts the Ray mine in an elite group of three deposits in the U.S. with reserves in excess of 1 billion tons.

Asarco's Silver Bell mine produces copper by dump leach precipitation. The open-pit mine and mill remain on stand-by status. The company has received an Aquifer Protection Permit for a new SX-EW plant that when completed is expected to produce 18,000 tons of refined cathode copper annually at substantially lower cost. Oxide ore is expected to come from a new area of the property known as Silver Bell North.

Azco Mining Inc.

Azco Mining announced in August, 1994 that it received all environmental permits needed to begin its Sanchez open pit copper mine near Safford. Financing was completed in November. It is estimated that construction will take one year, with production to be reached in early 1996. An SX-EW plant will be built and is expected to process 1.1 billion pounds of copper during Sanchez's anticipated 20-year life.

Cambior U.S.A.

Carlota Copper Company, a subsidiary of Cambior U.S.A., continues environmental permitting for its Carlota project located near Globe. The property consists of four oxide ore bodies, Carlota, Cactus and North and South Eder. Minable reserves total 107 million tons. Production is planned at a rate of 30,000 tons of copper per year for the first ten years via open pit mining, heap leaching and SX-EW.

MINERAL PRODUCTION IN ARIZONA - 1993

COMMODITY	QUANTITY	VALUE
Clay (tons)	130,000	$529,000
Copper (tons)	1,254,722	2,309,340,000
Gemstones		4,439,000
Gold (troy ounces)	110,920	39,377,000
Sand & gravel(tons)	36,900,000	136,500,000
Silver (troy ounces)	5,144,000	21,605,000
Stone-crushed(tons)	5,900,000	28,600,000
Pigments (tons)	100	62,000
Coal (tons)	11,673,000	274,000,000
Other [2]		201,051,000
TOTAL		$3,015,503,000

1/ Nonfuel figures from U.S. Bureau of Mines.

2/ Cement, clays (bentonite), gypsum, lime, molybdenum, perlite, pumice, pyrites, salt, sand & gravel (industrial), dimension stone, lead.

Cyprus Climax Metals Company

In November of 1993 Cyprus Minerals Company and AMAX Inc. merged to create Cyprus Amax Minerals Inc. and formed a new subsidiary known as Cyprus Climax Metals Company.

Cyprus was Arizona's second largest producer of copper in 1993 and continues to be the largest producer of molybdenum. Copper totals for 1993 were 632 million pounds of copper with an estimate of 725 million pounds for 1994. Cyprus Climax Minerals Company maintains corporate headquarters in Tempe, Arizona and operates five copper producing operations in the State: Bagdad, Casa Grande, Miami, Mineral Park, and Sierrita.

The Sierrita property consists of three open-pit copper-molybdenum mines, a 110,000-ton-per-day concentrator, two molybdenum roasting plants, a ferromolybdenum plant, a rhenium plant, a dump leaching operation, and an SX- EW plant. The mill capacity was increased by 10 percent in 1994 and a further increase is being considered. More than three quarters of Cyprus' molybdenum concentrate from Thompson Creek (Idaho), Bagdad, and Sierrita is processed at Sierrita through roasters to produce molybdenum oxide and ferromolybdenum.

The Bagdad operation consists of an open-pit copper-molybdenum mine, a 85,000 ton per day concentrator, a dump leach operation, and a 30 million pounds per year SX-EW plant.

The Casa Grande operation consists of an in-situ leaching operation and SX-EW plant. The Tohono O'Odham Nation has agreed to permit Cyprus Climax to develop a 600 million ton resource at Casa Grande. Metallurgical testing and permitting are underway on the open pitable deposit.

The Miami Mine consists of an open pit copper mine, formerly known as Inspiration, an SX-EW plant, a smelter recently expanded to a capacity of 650,000 tons per year, an acid plant, an electrolytic refinery, and a 135,000 ton per year rod plant. The 24,000 ton per day concentrator remains on standby status.

Cyprus operates a dump and in-pit leaching operation and precipitation plant at Mineral Park. The Mineral Park open-pit copper-molybdenum mine and its 15,000 ton per day concentrator remains on stand-by status.

Magma Copper Company

San Manuel, Pinto Valley, and Superior are Magma Copper company's three mining divisions in Arizona. Magma Copper Company's corporate headquarters are located at Tucson. Magma holds additional, undeveloped reserves at the Poston Butte and Copper Creek deposits. Magma acquired the Poston Butte deposit at Florence from Conoco in 1992. It began a 17-month feasibility study to evaluate the deposit as an in-situ leach operation in February, 1993.

The underground mine at San Manuel is the largest underground operation in the United States and the largest underground copper mine in the world. The San Manuel Division consists of a block-caving underground copper mine, a 62,000 ton per day concentrator, an open-pit oxide copper mine and heap leach, in-situ leach, SX-EW plant, a 1,300,000 ton per year smelter with a 3,000 ton per day acid plant and a 345,000 ton per year electrolytic refinery, and a 180,000 ton per year rod plant. During 1993 Magma Copper decided to proceed with a $135 million development of the downfaulted Kalamazoo ore body. Its estimated ore reserves of 2.2 billion pounds contained copper will add twelve years to the San Manuel underground mine. Production is planned to be phased in with the depletion of the San Manuel orebody over the period from 1997 through 1999.

Magma's San Manuel smelter accounts for about 25 percent of U.S. copper smelting capacity. Even though the Outokumpu flash smelting furnace was the largest single furnace smelter in the industry, a 20 percent expansion of its capacity was completed in March, 1994.

The Pinto Valley division includes the Pinto Valley mine and the Miami in-situ and Miami No. 2 tailings leach operations. The Pinto Valley mine consists of an open-pit mine, a 63,000-ton-per-day concentrator, dump leach and 8000 ton per year SX-EW plant. Miami's leach operations recover copper from in-situ leaching of the old Miami mine block cave area and by hydraulic mining and leaching of the old Miami tailings. The resulting pregnant leach solutions are processed through Miami's 10,000 ton per year SX-EW plant. Production at Pinto Valley increased 7.3 percent in 1993 due to an increase of in-situ production from Miami.

The Superior division consists of the company's namesake, Magma underground mine. This mine overcomes the difficult mining challenges of being hot, wet, and deep. That it remains in production is credited to its high grade ore, averaging 5.57% copper in 1993, ten times the average content of Arizona copper ore. Magma produced 33,612,000 pounds of copper in 1993.

Oracle Ridge Mining Partners

The Oracle Ridge Mining Partnership consists of Santa Catalina Mining Corp., (formerly South Atlantic Ventures Ltd.) who hold a 70% interest and operate the mine, and Continental Materials holding the remaining 30%. The underground Oracle Ridge mine produced concentrates containing 5.2 million pounds of copper in 1993. The company is planning to expand production to 1 million pounds per month.

Phelps Dodge Corporation

Phelps Dodge Corporation, headquartered in Phoenix, is the nation's largest copper producer. Its mining division, Phelps Dodge Mining Company, produces about one-third of the U.S.'s new copper at its mines in southeastern Arizona and southwestern New Mexico. In Arizona Phelps Dodge holds the Copper Queen Mine in Bisbee and the Morenci in Greenlee County. Morenci is the largest copper producer in North America and the second largest copper mine in the world. In 1993, Morenci produced 404,100 tons of copper! Phelps Dodge owns an 85 percent undivided interest in the Morenci Mine; the remaining 15 percent is owned by Sumitomo Metal Mining Company, Ltd. Morenci employees more than 2,000 people.

The Morenci operation consists of the Morenci, Metcalf, and Northwest Extension open-pit copper mines, the 60,000 ton per day Morenci concentrator with a molybdenum circuit, the 40,000 ton per day Metcalf concentrator, three dump leaches with SX plants and at a capacity of 170,000 tons annually, the worlds largest EW plant. Work began in the summer of 1994 on the $200 million expansion to the SX-EW facility. It is estimated that an additional 1.1 billion pounds of copper will be treated. The project will

develop the Southside deposit, on the south side of the Morenci pit, with reserves estimated at 150 million tons. The feasibility of adding a fourth open pit, Coronado, to the mining operation is under way. It hosts 480 million tons of sulfide and oxide ore.

The company's Copper Queen mine consists of a dump leaching and precipitation operation at the depleted Lavender pit. No decision has been made as to when to bring the adjacent Cochise deposit to production. Evaluation of the Lone Star and Dos Pobres deposits near Safford continues. Recent drilling at these deposits has increased identified resources to nearly 2 billion tons of open pitable material that could be recovered by heap leach SX-EW operations. The New Cornelia mine at Ajo remains inactive.

COAL

Coal is a distant second to copper in economic importance of mineral commodities produced in the State. In 1993 Arizona's coal production was 11,673,000 short tons, having an estimated value of $274 million. The high-quality coal is strip mined from the Kayenta and Black Mesa mines in central Navajo County. The coal is subbituminous with an average quality of 11,000 Btu, 0.5 percent sulfur, and 10 percent ash. All production is from land leased from the Navajo and Hopi Tribes by Peabody Western Coal Company. Indian royalties from coal production run about $30 million annually. Peabody is the nation's largest coal producer and Kayenta is their largest operation.

Kayenta Mine's production capacity is 8 million tons annually. The coal from the mine is carried by a conveyer system 17 miles to storage silos. From there it is transported by the electric-powered trains of the Black Mesa & Lake Powell Railroad to the Salt River Project Navajo Generating Plant 78 miles away. Kayenta has recently begun using a continuous miner to remove coal from seams underground.

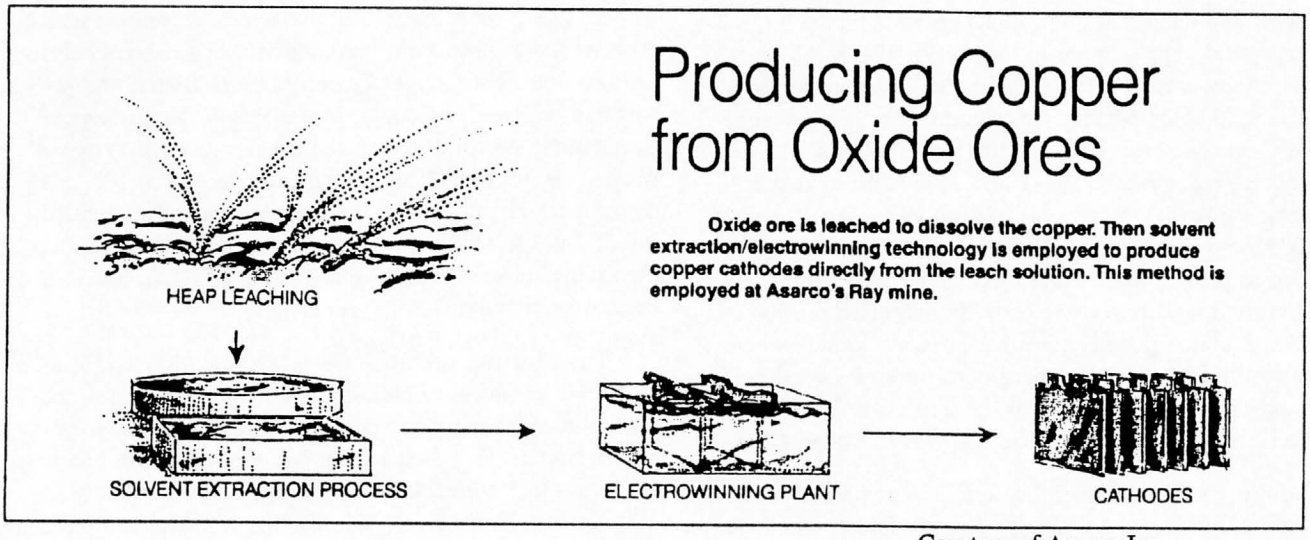
Black Mesa Mine's annual capacity is 4.5 million tons. Here, the coal is powdered and mixed with water prior to transport by the world's longest coal-slurry pipeline. The 273-mile journey to the Mohave Generating Station at Laughlin, Nevada takes three days. The Peabody operations at Black Mesa are model reclamation programs. Mining and reclamation proceed at the same rate of approximately 500 acres annually. As an area is mined, the topsoil is removed and stored. After mining is completed, the topsoil is returned and the surface is contoured. The resultant reclaimed land, used for grazing, is more productive than the original land.

Both mines are now using 300-ton capacity tractor trailer bottom-dump trucks to transport coal from the mine to the conveyors and pipeline feed plants.

GOLD

The Gold Prince mine, operated by Western States Minerals was the only gold mine in full-time production in 1994. It continues to produce gold-bearing silica flux for Phelps Dodge's Hidalgo Smelter in Playas, New Mexico.

Addwest Minerals Inc. received the necessary permits to reopen the Gold Road mine in the historic Oatman district. A decline has been driven and construction of a 500



Courtesy of Asarco Inc.

ton per day carbon-in-pulp mill should be completed during December of 1994.

Gold continues to be produced as a by-product of the copper industry in Arizona. Last year the major copper mines produced approximately 60,000 ounces of gold from the following mines: San Manuel, Magma, Morenci, Ray, Mission, Sierrita, Pinto Valley, and Oracle Ridge.

INDUSTRIAL MINERALS

Although copper accounts for three-fourths of the State's mineral production by value, mining in Arizona continues to be a diversified activity. Industrial minerals mined in the state last year include calcium carbonate as limestone and marble for mineral filler and as raw material for lime and cement plants, bentonite for desiccants and for bleaching and clarifying of edible oils, sand and gravel for construction aggregate, diatomite for metallurgical process insulation, tile and brick clay, salt, cinders, pumice for laundry uses and light-weight aggregate, zeolites for molecular sieves, stone, perlite for filters, gypsum for wall board and agriculture, silica flux, pyrite and micaceous hematite for pigment, quarried flagstone, and hydrafrac sand. Construction aggregates in the form of sand and gravel lead this industrial mineral group, both in volume and value of production. Salt River Sand & Rock operated the fourth largest sand and gravel plant in the nation in 1992.

Arizona's dimension stone industry is both larger and more significant than commonly perceived. The Drake-Ashfork area of Yavapai and Coconino Counties is the flagstone capital of America. Sandstone is cut, sawn, shaped, split, ground, and surfaced into a variety of products. Floor and wall tiles, building fascia, bench seats, sunning tables, pool decking, and furniture coasters are among its many uses.

Many market niches exist for the specialized industrial mineral producer. The tremendous range in employee and capital requirements for the industrial minerals commodities vary widely enough to accommodate a family-run operation as well as large corporate producers. The increase in the number of small decorative and dimension stone producers is an indication of this condition.

The Arizona Department of Mines and Mineral Resources' project to survey and quantify consumption of industrial minerals in Arizona's market area continues. The object of this project is to encourage exploration, development, and production of industrial mineral deposits in Arizona that can supply southwestern United States and northern Mexico markets.

GEMSTONES

Arizona is the leading state in the value of mined gemstones in the United States. Approximately $4.4 million worth of commercial gemstone production is reported for Arizona annually. Turquoise, peridot, and petrified wood account for most of the value, with amethyst, chrysocolla, azurite, malachite, and fire agate making up the remainder.

Turquoise, a hydrous phosphate of aluminum and copper, is the leading gemstone produced in Arizona. Prized for its color, turquoise is the traditional gemstone used in Southwestern American Indian jewelry. It is mined as a by-product at a number of Arizona porphyry copper deposits. The best quality material is sold by the piece, and the remainder sold or processed for sale by weight.

Peridot is the gem variety of the mineral olivine. The translucent green material comes from the Peridot Mesa area of the San Carlos Apache Indian Reservation east of Globe. Arizona material is suitable for faceting and is of the finest quality in the world. Occurring in Quaternary basalt, the olivine is mined by shallow drilling and blasting of productive zones followed by hand breaking, screening, and sorting.

Petrified wood, although occurring in nearly every state, is best known as an Arizona gem material. Petrified wood is a fossil in which a mineral material, usually silica, has replaced the original cellular structure of the wood. Petrified wood occurs in all Arizona counties, but that occurring in Navajo and Apache counties in the Triassic Chinle Formation supplies nearly all of the gem market. Commercial production comes only from private lands.

RECREATIONAL PROSPECTING

A rapidly growing segment of the Arizona mineral industry is that of recreational mining. This group includes gold-panners, lapidaries, and mineral and fossil collectors. Economic data for recreational mining is difficult to quantify, but the impact on the Arizona tourism industry is significant. The gem show in Quartzsite, for example, is the largest in the world, drawing in excess of 100,000 visitors. The prestigious Tucson Gem And Mineral Show attracts visitors and dealers from around the world. More than 20 additional gem shows are held in the state annually and 61 organized earth science clubs are currently active.

Gem material collected by the rockhound hobbyist is not included in the reported gemstone production, but it is likely that rockhound production is higher than the reported mine production. Some portion of rockhound-collected material goes directly into collections, however much of it is sold privately or at gem shows.