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ARIZONA'S MINING UPDATE - 1997

Circular No. 71, January, 1997

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Arizona set an all-time record in copper production in 1995, producing 1.3 million tons valued at over \$3.6 billion. Arizona continues leading the nation in the production of copper as well as in total non-fuel mineral production. The value of all mineral output was \$4.48 billion, an increase of 24 percent over 1994. In addition to copper, Arizona also leads or is among the leaders in the production of gemstones, molybdenum, silver, perlite, and sand and gravel. Excluding sand and gravel operations, there are 113 active mines in Arizona producing the above commodities plus additional metals and 18 varieties of industrial minerals. There are 78 sand and gravel producers in the state. More than 18,000 people are directly employed by the mining industry.

COPPER

Copper represents about 85 percent of Arizona's non-fuel mineral value. Significantly higher prices in 1995, when the producer cathode price averaged \$1.38 per pound, combined with record output of 2.6 billion pounds, gave the copper industry record operating earnings. Through the first five months of 1996 the price remained strong, averaging \$1.22. However, a major trading scandal involving Sumitomo was uncovered in late May that severely depressed prices in spite of tight inventories. The price for the period June through October fell \$.25, averaging only \$.97 per pound. As this time (11/96), the price seems to be firming at over a \$1.00/lb due to increasingly tight inventories and the belief that damage from the scandal is over. For the first 10 months of '96 the producer cathode price has averaged \$1.10.

Arimetco Incorporated

Arimetco produces cathode copper from the Johnson Camp mine and holds additional reserves at their Van Dyke, Zonia, and Emerald Isle copper properties.

Johnson Camp, located 65 miles east of Tucson, produced 6.3 million pounds of copper in 1995, up from 5.6 million pounds in 1994, as crushing of ore was implemented to improve leaching. Reserves at Johnson Camp's producing Burro Pit are estimated at 10 million tons, while the undeveloped Copper Chief orebody contains reserves estimated at 17.8 million tons.

1995 Copper Mine Production

Mine/Company	Production (lbs)	% of total
Morenci/Phelps Dodge	874,523,599	33.5
Ray/Asarco Inc.	329,106,694	12.6
San Manuel/BHP Copper	282,971,000	10.8
Sierrita/Cyprus Copper Co.	240,214,000	9.2
Mission/Asarco Inc.	227,762,115	8.7
Bagdad/Cyprus Copper Co.	214,931,000	8.2
Pinto Valley/BHP Copper	188,930,171	7.2
Miami/Cyprus Copper Co.	129,046,000	4.9
All others	125,840,837	4.9
Total	2,609,986,416	

The Emerald Isle open-pit mine and SX-EW plant located near Kingman has been on care and maintenance, but may reopen in 1997. Ore reserves are estimated at 0.87 million tons of 0.57 percent copper.

Asarco Incorporated

Asarco's Arizona operations consist of the Hayden copper smelter, two major open-pit mines, Mission and Ray, and a leaching operation at the Silver Bell mine. The mines' production was 563 million pounds of copper in 1995.

Mission complex, 18 miles south of Tucson, consists of two pits, Mission and the smaller, but separate, San Xavier North. 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 228 million pounds of copper in 1995.

In 1994 Asarco began developing a 5 million ton underground deposit located 400 feet lower and outside of the open pit limits at Mission. Access to the orebody is through declines driven from the base level of the Mission pit. The underground operation will add about 28 million pounds of copper per year.

The Ray mine, the second largest in Arizona, produced 329 million pounds in 1995. It consists of an open-pit mine, dump and heap leach operations, a 40,000 ton per year SX-EW plant at Ray, and two mills - a concentrator at Hayden and a 30,000 ton per day concentrator at Ray. The Ray mine is in an elite group of three deposits in the U.S. with reserves in excess of 1 billion tons. 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.

Asarco's Silver Bell mine continues to produce copper by dump leach precipitation while construction of a new \$70 million SX-EW plant is underway. The project is being developed with Mitsui and Co. Ltd. as a 25percent partner. Production is expected to commence in mid to late 1997 with a capacity of 18,000 tons of refined cathode copper annually. Oxide ore for the project will come from a new area of the property known as Silver Bell North that contains nearly 200 million tons of reserves.

Asarco, along with joint venture partner Freeport McMoran Copper and Gold, continues the in-situ leach research project at the Santa Cruz property in cooperation with the U.S. Bureau of Reclamation. In early 1996 construction of the test well site and SX-EW recovery plant was finished and injection of sulfuric acid into the undisturbed copper bearing formation begun. This technology, if successful, has the potential of extracting copper from deep deposits with very little impact on the environment.

BHP Copper

Magma Copper was acquired by Broken Hill Proprietary Company Ltd. (BHP) of Australia effective January, 1996. The merger made the BHP Copper the second largest copper producer in the world with 9 percent of mine production. San Manuel and Pinto Valley are the company's two active mining divisions in Arizona. The Magma mine at Superior closed in June of 1996. It produced 38 million pounds of copper in 1995. BHP has begun engineering and permitting for an in-situ leach SX-EW for the Poston Butte deposit.

San Manuel is the largest underground operation in the

MINERAL PRODUCTION IN ARIZONA - 1995

COMMODITY	QUANTITY	VALUE
Clay (tons)	110,000	\$463,000
Copper (tons)	1,317,000	3,600,000,000
Gemstones		3,761,000
Gold (troy ounces)	62,400	23,297,000
Sand & gravel(tons)	40,800,000	179,500,000
Silver (troy ounces)	6,327,000	33,116,000
Stone-crushed(tons)	5,950,000	27,500,000
Pigments (tons)	85	62,000
Coal (tons)	13,000,00	310,000,000
Other ¹		309,178,000
TOTAL		\$4,486,877,000

Nonfuel figures from U.S. Geological Survey, preliminary

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

United States and the one of the largest underground copper mines in the world. The San Manuel Division consists of a block-caving underground copper mine, a 62,000 ton per day concentrator, 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. It produced 282 million pounds of copper in 1995. Heap leach SX-EW production declined dramatically from 98 million pounds in 1994 to 48 million pounds in 1995 as no ore has been placed on the heap since the January, 1995 depletion of the open pit.

Development of the Lower Kalamazoo ore body at San Manuel is continuing. Its estimated ore reserves of 2.1 billion pounds contained copper will add 12 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. The Outokumpu flash smelting furnace is the largest single furnace smelter in the industry and 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

The Morenci operation consists of the Morenci, Metcalf, and Northwest Extension open-pit copper mines, the 100,000 ton per day Morenci concentrator with a molybdenum circuit, the 40,000 ton per day Metcalf concentrator, four dump leaches with SX plants, the new Southside EW plant with a 130 million pound capacity, and, at a capacity of 370 million pounds annually, the worlds largest EW plant. Morenci's milling and leaching reserves total over 1.5 billion tons.

The Coronado deposit hosts 480 million tons of sulfide and oxide mineralization. The near-by Western Copper deposit is estimated to contain 530 million tons of milling material at a grade of 0.55 percent copper, and 500 million tons of leach material at a grade of 0.31 percent copper. In 1994-95, a large resource of leachable material called Garfield, containing one billion tons grading 0.27 percent copper, was outlined north of the Metcalf mine. It is anticipated that continued drilling will result in a doubling of this resource.

The company's Copper Queen mine consists of a small dump leaching and precipitation operation at the depleted Lavender pit. No decision has been made as to when to bring the adjacent Cochise deposit, containing 210 million tons of 0.4 percent leach material, to production.

Phelps Dodge has a district office in Safford where evaluation and permitting of the Lone Star, Dos Pobres, and San Juan deposits continues. In late 1995, the Sanchez deposit was acquired from AZCO Mining. This increases the company's open pit, leachable copper resources in the district to nearly 2.4 billion tons. Dos Pobres also contains 330 million tons of sulfide reserves. Work is underway on a land exchange to facilitate development in the district.

The New Cornelia mine at Ajo remains inactive. During the last couple years the obsolete recovery plant and smelter have been dismantled and scrapped. The copper resource there is 160 million tons grading 0.56 percent copper.

Phelps Dodge and Cominco announced a joint venture agreement for the United Verde massive sulfide deposit at Jerome. The property contains a 21 million ton resource at 6.6% zinc, plus copper and precious metals.

COAL

Coal is a distant second to copper in economic importance of mineral commodities produced in the State. In 1996 Arizona's coal production was 13,192,000 short tons, having an estimated value of \$300 million. All production is from land leased from the Navajo and Hopi Nations by Peabody Western Coal Company. Royalties from coal pro-

duction total \$30 million annually. Peabody is the nation's largest coal producer and Kayenta is their largest operation.

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. 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.

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.

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 about three days.

Peabody's 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.

GOLD

Addwest Minerals Inc., was sold by Addington Resources in December, 1995 to a group of private investors. The company continues to operate the Gold Road mine and mill at Oatman. The Gold Road has recently acquired the distinction of being the sole producing primary gold mine in Arizona, although hopefully it will not hold that distinction for long.

BEMA Gold, doing business in Arizona as Yarnell Mining Company, continued permitting efforts for its Yarnell deposit that contains 7.3 million tons of 0.037 oz. per ton Au. The planned open pit heap leach hopes to receive the final EIS in September, 1997 and to begin construction immediately thereafter.

Cochise Resources closed the Golden Rule mine in Cochise County. Its 20 ton per day gravity and flotation mill is available as a custom mill.

Gold continues to be produced as a by-product of the copper industry in Arizona. Last year the major copper mines produced approximately 50,000 ounces of gold from

operations. The Pinto Valley mine consists of an open-pit mine, a 63,000-ton-per-day concentrator, dump leach and 8,000 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. Pinto Valley produced 189 million pounds of copper and the two Miami leach units 23 million pounds in 1995.

Cambior U.S.A.

Construction of the Carlota mine of Carlota Copper Company, a subsidiary of Cambior U.S.A., continues to be delayed. The long awaited Environmental Impact Statement from Tonto National Forest, expected to be received by January 1996, was still not completed as of November, 1996. It is hoped to be obtained in early 1997 with construction to immediately follow. The property consists of four oxide ore bodies, Carlota, Cactus, and North and South Eder. Mineable reserves total 96 million tons grading 0.44 percent copper. 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.

Cyprus Climax Metals Company

Cyprus is Arizona's second largest producer of copper and the world's largest producer of molybdenum. Copper totals for 1995 were 621 million pounds of copper. Cyprus Climax Minerals Company maintains corporate headquarters in Tempe, Arizona and operates five copper mines in the State: Bagdad, Tohono, 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. 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. Sierrita is recognized as one of the most efficient mines in the world as it operates with the lowest average copper grade, 0.27 percent, of any milling operation. Sierrita contains proven and probable reserves to last 20 years at its present mining rate of almost 50 million tons per year.

The Bagdad operation consists of an open-pit copper-molybdenum mine, a 85,000 ton per day concentrator, a dump leach operation, and a SX-EW plant. In 1995 Bagdad produced 31 million pounds, or 15 percent of its total copper production, as electrowon copper cathode. Cyprus reported in 1995 that Bagdad has over a billion ton proven and

probable ore reserve of 0.38 percent copper and 0.021 percent molybdenum.

Cyprus' Tohono operations consists of an SX-EW plant fed by a newly developed test open pit and heap leach. In 1995 Tohono produced 34 million pounds of copper, an increase of over 10 million pounds. Cyprus mined 8.4 million tons in 1995 despite reporting only 12 million tons of reserves. A 600 million ton resource could become reserves if heap leaching operations continue to be successful.

The Miami mine consists of an open-pit copper mine, an SX-EW plant, a 650,000 tons per year capacity smelter, an acid plant, a 380 million pound electrolytic refinery, and a 135,000 ton per year rod plant. Miami produced 129 million pounds of copper in 1995 and has increased the capacity of its SX-EW plant to increase production in 1995. The investments in the smelter and refinery at Miami have made Cyprus more efficient and self sufficient in domestic copper smelting and refining.

At the Mineral Park open-pit copper-molybdenum mine in Mohave County, Cyprus converted the in-place leach and precipitate operation to an SX-EW operation capable of producing 6 to 8 million pounds of copper per year. Production resumed in November 1994 and during 1995 produced over 3 million pounds of copper. A research project studying the feasibility of in-situ leaching a fracture hosted chalcocite deposit is underway.

Phelps Dodge Corporation

Phelps Dodge Corporation, headquartered in Phoenix, is the nation's largest copper producer and the world's largest producer of SX-EW cathode copper. Its mining division, Phelps Dodge Mining Company, produces about one-third of the U.S.'s mined copper at its properties in southeastern Arizona and southwestern New Mexico. The company broke all production and financial records in 1995. In Arizona Phelps Dodge operates the Morenci mine complex in Greenlee County and the Copper Queen in Bisbee, and hold significant undeveloped copper resources throughout the state. Phelps Dodge owns an 85 percent interest in the Morenci mine; the remaining 15 percent is owned by Sumitomo Metal Mining Company, Ltd. The mine employs more than 2,000 people.

Morenci is the largest copper producer in North America and the fourth largest copper mine in the world. In 1995, Morenci produced a record 875 million pounds of copper!, one third of Arizona's total, from 74 million tons of ore. This copper production is 25 percent more than the record set in 1994. For the first time ever copper recovered by leaching SX-EW exceeded that from flotation concentrates.

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, smelter slag, pumice for laundry uses and light-weight aggregate, zeolites for molecular sieves, crushed stone, decomposed granite, perlite for filters, gypsum for wall board and agriculture, silica flux, hematite for pigments, 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. For 1994 and the first quarter of 1995 Arizona's sand and gravel production ranked third in the United States. For the same period Arizona's position in total construction aggregate production (sand and gravel combined with crushed stone) was eleventh in the country. In 1995 Salt River Sand & Rock located in Maricopa County operated the second largest sand and gravel plant in the U.S.

GEMSTONES

Arizona is a leading state in the value of mined gemstones in the United States. Approximately \$3.7 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 Native American jewelry. It is mined as a by-product by contractors 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. Byproduct turquoise is produced by Yellow Hair Trading and Mining from the Sleeping Beauty Mine at Pinto Valley and by Colbaugh Processing from the Mineral Park Mine. Although long known for their turquoise, the Morenci Mine and the deposits at Bisbee are currently yielding very little.

Peridot is the gem variety of the mineral olivine. The translucent green material comes from the Peridot Mesa area of the San Carlos Apache Reservation east of Globe. Arizona material is suitable for faceting and is the finest quality in the world. Peridot ranks second in gemstone value in Arizona, but this deposit accounts for approximately 90% of the world's production.

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.

Gem material, mineral specimens, and fossils collected by the rockhound hobbyist are 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 processed by lapidaries, and sold privately or at gem shows. 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 25 additional gem shows are held in the state annually and 37 organized earth science clubs are currently active.

RECREATIONAL PROSPECTING

An important segment of the Arizona mineral industry is that of recreational mining. This group includes primarily gold-panners and operators of small hobby-type suction dredges. Although some gold is likely recovered by nearly all who participate in this form of recreation, the recreational value nearly always outweighs the value of gold produced. Economic data for recreational mining is difficult to quantify, but the impact on the Arizona tourism industry is significant.

Government regulations are leaning heavier and heavier on the recreational 'rockhound' and are likely to get even more restrictive.