

Arizona Mining Update for 1999

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For the first time in 10 years, Arizona did not rank first in the Nation in non-fuel mineral production in 1998, falling to third. Arizona's production was \$3.0 billion, down \$800 million from 1997. Contributing to this drop was an 11-year low in copper prices. Preliminary figures released from the USGS indicate that Arizona was also third in 1999 with total production valued at \$2.7 billion. During 1999, copper prices fell 3 cents more to 72 cents per pound, the lowest annual average price (in constant dollars) in the century.

Arizona did continue to lead the Nation in copper production, accounting for 65 percent of the total U.S. mine production. In addition, Arizona is among the leaders in the production of gemstones, molybdenum, silver, perlite, and sand and gravel. There are 72 mining companies operating 126 mines in the state, with an additional 70 sand and gravel producers. More than 15,000 people are directly employed by the mining industry.

Arizona Mineral Production - 1998 - 1999¹

(short tons unless otherwise noted)

Commodity	1998 Quantity	1998 Value	1999 ¹ Quantity	1999 Value
Copper	1,312,000	2,060,000,000	1,213,000	1,810,000,000
Gemstones	na	2,120,000	na	1,920,000
Gold (troy oz.)	59,160	17,400,000	24,500	6,870,000
Molybdenum (lbs.)	36,600,000	withheld	37,000,000	withheld
Sand & Gravel				
Construction	52,800,000	229,000,000	59,500,000	264,000,000
Industrial	338,000	3,290,000	289,000	4,120,000
Silver (troy oz)	6,780,000	34,700,000	6,080,000	32,500,000
Stone, crushed	8,910,000	44,800,000	9,040,000	46,700,000
Other ²	na	370,000,000	na	344,000,000
Coal ³	11,300,000	272,000,000	11,787,000	283,000,000
Total		\$3,030,000,000		\$2,790,000,000

Copper

Low copper prices and increased foreign production resulted in a difficult period for copper producers last year. Arizona's copper production declined 4.8 percent in 1998 and fell 7.5 percent in 1999 to 2.42 billion pounds. The value of copper produced had an even more dramatic decline, dropping 29.9 percent in 1998 and 12.1 percent in 1999. Producers changed the goal of their operations, returning to the mantra of the late 1980s, achieving low-cost production, rather

than maximizing production as they had been doing for most of the 90s. In addition to cutting costs and reducing production, the major Arizona copper companies attempted to improve their competitive position in a changing world market through mergers and acquisitions.

In December 1999, following five months of offers, Phelps Dodge acquired Cyprus Amax and is now the world's second largest producer of copper. Phelps Dodge acquired the following operating mines in Arizona: Sierrita, an open-pit copper-molybdenum mine, Miami, an open-pit leach copper mine, smelter, and refinery, and Bagdad, a copper-molybdenum mine. Phelps Dodge also acquired Cyprus' position as the world's largest molybdenum producer. The total equity value was \$1.8 billion based on approximately 90.7 million Cyprus Amax shares outstanding.

In November, Grupo Mexico, S.A. de C.V. purchased Asarco Inc. to become the third largest copper producer in the world. The Arizona producers acquired include: Mission, an open pit copper mine, Silver Bell, a leach copper mine north of Tucson, the Ray complex that includes an open-pit copper mine and the Hayden smelter.

The merger activities began in July of 1999 when Asarco and Cyprus announced a merger of equals' transaction. The company thus created would have been the largest producer of copper in the world. However in August, Phelps Dodge initiated an unsolicited takeover attempt of both companies, offering a 30 percent premium over the companies' existing share prices. This offer was rejected and Phelps Dodge increased the offer. The Antitrust Division of the Department of Justice quickly issued clearance for the acquisition of Asarco and Cyprus without any divestitures. Later in August, Grupo Mexico made an offer to acquire Asarco. In October, Asarco's board of directors accepted Phelps Dodge's offer of \$29.50 cash per share and the merger was signed, contingent upon 80 percent of the shares being tendered by October 22 and approval by Phelps Dodge's shareholders. Grupo Mexico increased their offer the next day to \$29.75 per share and that offer was eventually accepted. When the companies merged, all Asarco shares were acquired for \$29.75 cash for a total transaction value including assumed debt of \$2.25 billion. Asarco paid a \$30 million termination fee to Phelps Dodge. A passing note: 1999 marked the 100th anniversary of Asarco who commemorated it by releasing *Asarco 1899 - 1999, Celebrating a Century of Accomplishment*.

Before the merger activity began attention had been focused on BHP whose North American copper operations were for sale. Not receiving any acceptable offers, BHP made the decision in June 1999 to close their copper properties, excluding leach production. The San Manuel mine, smelter, and refinery complex, along with the Pinto Valley mine, remain closed and await a buyer.

As copper prices remain low and inventory levels high it is difficult to predict which properties will remain in production, but change is certain. For example at Morenci, North America's largest copper mine; Phelps Dodge plans to phase out sulfide concentration and go to leach-only operations by 2001.

On an optimistic note, copper prices, down as low as 61 cents/lb in May 1999, gradually improved to 83 cents/lb by year's end. Although there is the possibility for more surprises in the Arizona copper industry, it appears that, temporarily at least, the dust has settled.

Arizona Copper Production - 1997-1998

(million lb.)

Mine, Company	1997	1998
Morenci, Phelps Dodge	1,084	1,046
Ray, Asarco	304	335
San Manuel, BHP*	251	271
Mission, Asarco	252	255
Sierrita, Cyprus	246	226
Bagdad, Cyprus	246	215
Miami, Cyprus	156	164
Silver Bel, Asarco and Mitsui	19	42
Pinto Valley, BHP*	157	37
Tohono, Cyprus	27	8
Mineral Park, Equatorial**	+3	6

Asarco Inc., (a wholly owned subsidiary of Grupo Mexico, S.A. de C.V.)

Grupo Mexico purchased Asarco Inc. in November 1999. Asarco's copper operations in Arizona include the open-pit mines of Ray and Silver Bell, an open-pit and underground operation at Mission, the Hayden copper smelter, and the Santa Cruz in situ research project. Ray and Mission are the second and third largest copper mines in Arizona.

Grupo Mexico, headquartered in Mexico City, is Mexico's largest mining company and the third largest copper producer in the world. The two divisions of the company are Grupo Minero Mexico, the mining division, and Grupo Ferroviario Mexico, the railroad division. Grupo Mexico's sales in 1998 totaled \$1.4 billion.

Ray

Copper output at the Ray mine was up from 1997 to 335 million pounds, of which 91 million pounds came from its SX-EW operations. This 24 percent increase was the result of using new leaching technology involving higher acid concentrations in the leach dumps. In July of 1999 an annual 80-million-pound reduction in production was announced for Ray and Mission. This was forecast to reduce Asarco's 1999 North American production by about 7 percent. At Ray, harder ore would reduce output by 25 million pounds. As part of a negotiated settlement with EPA and State agencies to resolve environmental issues Asarco will extend the Mineral Creek diversion tunnel around the Ray mine workings at a cost of \$55 million. When completed this project will result in shortened hauls and add greatly to leach and dump capacity.

Ray consists of an open-pit mine, dump and heap leach operations, an 80-million-pounds-per-year SX-EW plant at Ray, and two mills - a 28,000-ton-per-day concentrator at Hayden and a 32,000-ton-per-day concentrator at Ray. At the end of 1998 Ray had reserves of 951 million tons grading 0.6 percent sulfide copper and 177 million tons of leachable copper grading 0.45 percent.

Mission

Mission's copper production in 1998 was 255 million pounds, up 4 million pounds from 1997. This increase was attributed to new loading and hauling equipment including a large overland conveyor system designed to move 58 million tons of waste per year. More importantly, it reduced waste haulage costs 11 percent. Accounting for 43 percent of Arizona's silver production, Mission was Arizona's largest silver producer with 2.55 million ounces recovered as a by-product. The cutback announced for Mission in 1999 lays off 150 employees and trims copper production 55 million pounds annually.

The Mission complex consists of the underground mine and two pits, Mission and the smaller, but separate, San Xavier North. Sulfide ore is treated at two mills, Mission and South, with a combined capacity to process 63,000 tons of ore daily. Mission's reserves at the end of 1998 exceeded 494 million tons grading 0.7 percent copper.

Hayden

The Hayden smelter, an INCO flash furnace rated at 720,000-tons-of-charge per year processed a record amount of concentrates during 1998, producing 381.8 million pounds of copper. Modernization of the smelter's gas handling system and the process control system was completed in 1998.

Silver Bell

Silver Bell produced over 40 million pounds of SX-EW copper in 1998, 17.5 percent above design capacity. Asarco began mining the Silver Bell North deposit, part of the Silver Bell complex near Tucson, and dedicated the mine and new processing facility on July 16, 1997. The facility's new \$70-million SX-EW plant was developed as a joint venture with Mitsui & Co. U.S.A. (25 percent share) and has produced at its design rate of 36-million-pounds-per-year since start up. Rubblization and leaching of material in the El Tiro and Oxide pits also provides solution to the SX-EW plant. Asarco reports cash costs to be 50 cents per pound.

BHP Copper

In June 1999, BHP announced that the San Manuel underground mine and smelter would be closed, eliminating 2,200 jobs. About 430 workers continue to work at the rod plant and in-situ leach at San Manuel and the leach operations at Miami and Pinto Valley. Prior to these layoffs BHP was the State's largest copper employer.

San Manuel

San Manuel, on care and maintenance, is the largest underground operation in the United States and one of the largest underground copper mines in the world. San Manuel consists of a block-caving underground copper mine, a 62,000-ton-per-day concentrator, in-situ leach, a 60,000-ton-per-year SX-EW plant, a 1,300,000-ton-per-year smelter with a 3,000-ton-per-day acid plant, a 690-million pounds-per-year electrolytic refinery, and a 180,000-ton-per-year rod plant.

San Manuel produced 271 million pounds of copper in the fiscal year that ended May 1, 1999. By-product gold recovered was over 23,000 ounces for the same period.

The Lower Kalamazoo orebody has estimated ore reserves of 2.5 billion pounds of contained copper. San Manuel's and Lower Kalamazoo's ore reserves were 226 million tons of sulfide ore at an estimated grade of 0.62 percent copper as of 1998.

BHP's San Manuel smelter is the largest single furnace smelter in the industry. The smelter had been operating since 1988 without a rebuild, a record time for copper smelters. The smelter was shut down for 2 months in the spring of 1999 for a \$66 million rebuild and modernization. Improvements included installing a new burner design, new draft fans and waste heat boiler, construction of a 40,000-ton concentrate storage building, and improving the conveyor systems to reduce spillage and airborne contamination. These changes will increase the flash smelter volume and result in lower SO₂ emissions. The project was completed but the smelter did not restart due to the mine closure.

Pinto Valley

The Pinto Valley division includes the closed Pinto Valley sulfide mine, and the Miami in-situ leach and Miami No. 2 tailings leach operations. Miami's operations recover copper from in-situ leaching of the old Miami mine block cave area and by hydraulic mining and leaching of the Miami No. 2 Tailings pile. The resulting pregnant leach solutions are processed through Miami's 20-million-pound-per-year SX-EW plant. The Miami in-situ project contains 172 million tons at an average grade of 0.40 percent copper, while only 9 million tons at 0.40 percent remain to be processed at the No. 2 Tailings pile.

Florence

BHP's Florence in-situ leach project has completed permitting, but start up plans have been postponed. Oxide resources for the project are 321 million tons averaging 0.34 percent copper that are expected to produce 72 million pounds of cathode copper per year for 15 years.

BHP reported discovery of the Magma Porphyry near Superior in mid-1998. It is the first major copper discovery announced in Arizona in many years. The deposit, deeply buried under post-mineral rocks, was first intersected by drill holes from the underground workings of the Magma mine in 1995. Assays from the bottom 1,004 feet of intercept yielded arithmetic mean grades of 1.75 percent copper and 0.029 percent molybdenum. The last 619 feet assayed 2.18 percent copper and 0.028 percent molybdenum! The dimensions of the Magma Porphyry deposit are still incompletely defined, but it is at least 1,500 feet high, 2,100 feet long, and 600 feet wide. The

top of the deposit is approximately one mile beneath the surface and the host rocks are reported to have high temperatures similar to or higher than those encountered in the Magma mine.

Phelps Dodge Corporation

In December 1999 Phelps Dodge acquired Cyprus Amax Minerals' operations in Arizona, making Phelps Dodge the second largest copper company in the world, trailing only Codelco, the government-owned Chilean company. Phelps Dodge Corporation, headquartered in Phoenix, is the world's largest producer of SX-EW cathode copper. Its mining division, Phelps Dodge Mining Company, post merger will produce about one-half of the U.S.'s mined copper from its properties in Arizona and southwestern New Mexico. The purchase also made Phelps Dodge the world's largest molybdenum producer, a position Cyprus had held. The company's Morenci mine in Greenlee County, the largest copper mine in North America, had an annual production of over 1 billion pounds of copper in 1998 and 887.8 pounds in 1999. Phelps Dodge owns an 85 percent interest in the Morenci mine; Sumitomo Metal Mining Company, Ltd owns the remaining 15 percent. In Arizona, in addition to Morenci, Phelps Dodge operates the Copper Queen in Bisbee, and controls significant undeveloped copper resources throughout the state, including several deposits near Safford and the New Cornelia mine at Ajo. The newly acquired operations from Cyprus include Bagdad, Miami, and Sierrita, and other non-producing deposits.

Morenci

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 three SX plants, the new Southside EW plant with an annual capacity of 130 million pounds, and Morenci, with an annual capacity of 370 million pounds, the worlds largest EW plant.

Morenci produced 494 million pounds of copper by concentration in 1998. This dropped about 100 million pounds to 390 million in 1999 largely due to the closing of the Metcalf concentrator in August. The closure was part of a plan announced to reduce costs by phasing out sulfide concentration and converting Morenci to an all leach operation by 2002. As part of the expansion of leach output, construction has begun on installing mechanical stackers and agglomeration equipment. Although the Metcalf concentrator was written off for \$88 million in the fourth quarter of 1999 its crushing plant will continue to be used for leach operations. The larger Morenci concentrator will be phased out during the next 2 years, but will be maintained to provide flexibility in production. No layoffs are expected to occur from the Morenci concentrator closure. Employees will be reduced through attrition or reassigned to work elsewhere in the mine, however 250 contract employees were laid off with the Metcalf's mill closure.

Morenci's milling reserves totaled over 416 million tons grading 0.64 percent copper, while leaching reserves totaled over 1.86 billion tons at the end of 1999. Additional resources at Morenci include: Western Copper with an estimated 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; Garfield, containing 1 billion tons grading 0.27 percent copper; and American Mountain, containing 140 million tons of leach material grading 0.25 percent copper.

Sierrita

In response to low copper prices during 1998, Cyprus announced it was reducing copper production by 60 million pounds from Bagdad and Sierrita. These cutbacks were made by reducing the use of their highest cost, and more productive, equipment. Additionally expenditures are being reduced by \$10 million by deferring equipment purchases and holding other expenses to sustaining levels.

The Sierrita property consists of three open-pit copper-molybdenum mines, a 115,000-ton-per-day concentrator, two molybdenum roasting plants, a ferromolybdenum plant, a rhenium plant, and an oxide and low grade sulfide dump leaching operation with SX-EW plant. In 1996 Sierrita started mining a 70-million-ton oxide deposit that has led to increased leach output. Cathode production during 1998 was a record 48 million pounds. A record mill tonnage processed resulted in 178 million pounds of copper in concentrates. Cost cutting efforts resulted in a 17 percent reduction in cash unit costs per pound. The mine's by-product molybdenum credit was 22 million pounds in 1998. That was a third of Cyprus' moly production and made Sierrita the largest molybdenum producer in Arizona. At the end of 1999 Phelps Dodge reported Sierrita contains sulfide reserves of 1.063 billion tons grading 0.27 and oxide reserves of 64 million tons grading 0.18 percent copper.

Bagdad

The Bagdad mine in Yavapai County produced 215 million pounds of copper in 1998, a 13 percent decline from 1997's record level. Compared to a year earlier, a seven percent drop in cash costs, normalized to grade of copper mined, was achieved. This resulted from finer ore grind, improved control of the flotation circuit, and other minimal capital efforts. The operation consists of an open-pit copper-molybdenum mine, a 85,000-ton-per-day concentrator, an oxide dump leach operation, and an 30-million-pound-per-year SX-EW plant. Phelps Dodge reported that at the end of 1999 Bagdad had a 775 million ton sulfide reserve of 0.37 percent copper and 0.02 percent molybdenum, as well as 16 million tons of leach material of 0.29 percent copper.

Miami

The Miami mine consists of an open-pit copper mine, an SX-EW plant, a 650,000-ton-per-year capacity smelter with acid plant, a 380-million-pound-annual capacity electrolytic refinery, and a 135,000-ton-per-year rod plant. All Miami's operations had outstanding levels of production in 1998. The mine and SX-EW plant produced a record 164 million pounds of copper in 1998, a 5 percent improvement over the 1997 record. The smelter processed 605,000 tons of copper concentrates from other operations. The electrorefinery produced 380 million pounds of cathode and the rod plant operated above capacity and produced 306 million pounds of copper rod in 1998, both amounts were new records. At the end of 1999 Phelps Dodge reported leach reserves for Miami of 189 million tons grading 0.38 percent.

Tohono

The Tohono operations, located on land leased from the Tohono O'Odham Nation, consists of an SX-EW plant fed by a test open pit and heap leach. Although mining was suspended in July 1997, leaching of existing heaps continued until February 1999. Production at Tohono totaled 8 million pounds of copper during 1998.

Copper Queen

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.

Safford

Phelps Dodge opened a district office in Safford where feasibility studies and environmental permitting were initiated in 1996 for the Lone Star, Dos Pobres, and San Juan deposits. The draft EIS was released in min-1998. The Dos Pobres and San Juan deposits contain 555 million tons of leachable material and 330 million tons of sulfide material with a grade of 0.65 percent copper. The acquisition of the Sanchez deposit in 1995 increased the company's open pit, leachable copper resources in the district, including Lone Star, to nearly 2.4 billion tons.

New Cornelia

In 1997 Phelps Dodge announced that a \$238 million construction project is planned for the New Cornelia mine at Ajo. The project, scheduled to include a new concentrator and mining equipment, will allow resumption of mining the deposit that last operated in 1983. The sulfide resource there is 150 million tons grading 0.56 percent copper. The New Cornelia operation, which will employ about 400 people, is expected to produce 135 million pounds of copper and 25,000 ounces of gold annually. The project is mothballed pending improved copper prices.

United Verde

Phelps Dodge and Cominco continue a joint venture exploration agreement on the United Verde massive sulfide deposit at Jerome. The property, one of the largest zinc resources in the U.S., contains 21 million tons grading 6.6 percent zinc, plus copper and precious metals.

Other Copper Companies

After six years of effort the Carlota open pit heap leach SX-EW project is now fully permitted. Carlota Copper Company, a subsidiary of Cambior U.S.A. received a favorable ruling on litigation contesting the Forest Service's record of decision in August of 1999. The plaintiffs' allotted time to file an appeal has expired. Carlota Copper Company acquired the Carlota project in August of 1991 and applied for permits in February of 1992. Since that time various environmental groups have tried to obstruct the mine even though the local community has favored the project and the company has met all conditions for permitting. The property consists of four oxide ore bodies, Carlota, Cactus, and North and South Eder with reserves that 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 10 years via open-pit mining, heap leaching, and SX-EW. Capital costs are estimated at \$100 million. The project will employ 300 workers when in full operation, with a \$125,000,000 annual contribution to Arizona's economy. When startup is achieved Carlota will be the first new, major mine in Arizona in many years. Unfortunately heavy debt problems related to Cambior's gold hedging activities have put the company in the position of having to offer the project for sale as of late 1999.

Equatorial Mining exercised their option to purchase Mineral Park from Cyprus Climax Metals Company on October 1, 1997. Mineral Park is an open-pit copper-molybdenum mine located in Mohave County. Production of 6 million pounds of copper per year currently comes from a combination of dump and bench leaching. In October 1999 Equatorial secured a 3 year option on the Zonia mine, Yavapai County from bankrupt Arimetco. A pre-feasibility study is planned to evaluate the property's 142-million-ton resource grading 0.31percent Cu.

On July 1, 1998 the AMT international Mining announced they will purchase BHP's 50 percent interest in a portion of the Copper Creek project. AMT has also purchased several other properties in the district, including the 37,000-acre Mercer Ranch adjacent to the project. AMT has since completed 12 drill holes hitting high grades of copper (~1.0 percent) and molybdenum (~0.31 percent) in several holes.

Nord Resources of Albuquerque acquired Johnson Camp mine in Cochise County from Summo Metals in the spring of 1999. The mine, currently on care and maintenance, continues to produce 1 to 2 million pounds of copper annually by SX-EW from existing heap leaches. With a rise in copper prices the mine is expected to reopen with a production of cathode copper of 18 million pounds per year.

Coal

Peabody Group, parent company of Arizona's Peabody Western Coal Company is the world's largest private sector coal company. Coal ranks second only to copper in economic importance in the State. In 1998 Arizona's coal production was 11,315,000 short tons, having an estimated value of \$272 million. All production is from land leased from the Navajo Nation and Hopi Tribe by Peabody. Royalties from coal production total \$30 million annually.

High-quality, low-sulfur 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 coal is carried by a conveyor system 17 miles to storage silos. Electric-powered unit trains of the Black Mesa & Lake Powell Railroad transport 78 miles to Salt River Project's Navajo Generating Plant at Page. At Black Mesa 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.

Peabody's operations on 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. More than 10,000 acres have been reclaimed, with the land put back to hardy range that is least 10 times more productive than before mining.

Gold and Silver

By-product recovery of gold and silver from the sulfide copper operations was reported at 67,000 troy ounces gold and 5.95 million troy ounces silver in 1998. Low gold prices, dropping slightly to average below \$280 per ounce in 1999, continued to have a negative impact on activity. Bema, dba in Arizona as Yarnell Mining, ceased funding of the NEPA/EIS for the Yarnell gold project and closed their engineering office in August delaying their open pit heap leach operation until prices improve.

Only a few gold exploration projects were active. The Moreau property, a detachment hosted target in La Paz County, was drilled by Nevada Pacific Gold in late spring. Exploration of the property was continued by Echo Bay who optioned the property in the fall.

Another detachment-hosted deposit, the past producer Copperstone, continued to be of interest. However, Royal Oak's bankruptcy hindered efforts by subsidiary Arctic Precious Metals to continue exploration. Asia Minerals has acquired the project, reported an underground resource of nearly 500,000 ounces, and plans further drilling.

Industrial Minerals

Although the mining of copper and its by-products accounts for 80 percent of the State's mineral production by value, mining in Arizona continues to be a diversified activity. Coal and industrial minerals largely account for the remaining 20 percent. Sand and gravel for construction aggregates, cement, and lime for chemical and construction material uses make up the majority of industrial mineral value. In 1999 Salt River Sand & Rock, located in Maricopa County, again operated the second largest sand and gravel plant in the U.S.

Sand and gravel is increasingly important as Arizona, especially the metro Phoenix area continues its rapid growth. The valley's construction industry was paced by the addition of 30,000 plus new homes per year in 1998 and 1999 and associated commercial construction. Creating additional demand is the accelerated urban freeway and rural highway-building program of the Arizona Department of Transportation. The Federal government passed the Transportation Equities Act for the 21st Century (aka TEA-21), a multi-year highway-funding bill that is expected to increase highway construction spending. This rapidly growing demand for aggregates and concrete has attracted global players including Pioneer International, Hanson PLC, Vulcan Materials, and Cemex to Arizona.

Australia's Pioneer International continued its rapid pace of acquisitions of sand and gravel and concrete producers in Arizona by buying Phoenix Redimix, Wickenburg Concrete and Materials,

Valley Concrete and Materials (of Clarkdale), and Yavapai Materials during 1999. The purchase of Phoenix Redimix Inc. for approximately \$50 million by itself added more than 30 million tons of aggregate reserves with a life of 15 years at current production rates. With the latest acquisitions Pioneer is now the second largest concrete producer and fourth largest aggregate supplier in Arizona, operating 12 batch plants and 6 quarries. Combined annual sales from over 1 million cubic yards of concrete and 4 million tons of aggregate are expected to be over \$100 million.

In November of 1999 United Kingdom-based Hanson PLC and Pioneer International agreed to an offer by Hanson to acquire Pioneer for about \$2.54 billion. The combination of these two companies will create one of the world's largest heavy building materials corporations involved in the production of aggregates, ready mix concrete, concrete products, cement, and clay bricks in four continents across the world. The newly combined group will become the world's largest supplier of aggregates, replacing Vulcan Material's ranking in that category. The new group will also be the world's second largest supplier of ready mix concrete.

Vulcan Materials, the nation's largest aggregate producer, completed its acquisition of Calmat in a deal that began in November of 1998 and closed in January 1999. The purchase totaled \$760 million plus assumption of Calmat's debt of \$130 million. Calmat's southwest US operations included Calmat of Arizona with 479 employees at seven Phoenix area plants.

The globalization trend continued as yet another international company, CEMEX, the world's third largest cement producer, revealed its brand in Arizona as Sunward Materials, doing business as CEMEX USA -Arizona.

Other industrial minerals mined in the state are more interesting in terms of their variety than their dollar value. These include limestone and marble, bentonite, diatomite, common clays, salt, cinders, smelter slag, pumice, zeolites, crushed stone, decomposed granite, perlite, gypsum, silica flux, hematite, sandstone, dimension stone, industrial sand, and mine tailings.

Calcium carbonate is mined as limestone and marble for mineral filler and as raw material for lime and cement plants. The zeolite minerals, chabazite and mordenite, are mined for processing into molecular sieves and for waste treatment. Diatomite is produced for metallurgical process insulation. Salt is crystallized by solar evaporation from brines produced by solution mining for use in food processing, livestock feed, and chemicals. Perlite is mined for processing into filter media, fillers, and carriers. Quartz and quartzite is mined for use as silica flux in copper concentrate smelting. Industrial sand is produced for use as hydrafrac sand used in petroleum production. Mill tailings from a closed zinc mine are processed into fertilizer. This enables the tailings to provide iron, sulfur and other trace elements, along with added nitrogen, to be used by plants. Bentonite is mined for out-of-state processing into desiccants and for bleaching and clarifying of edible oils.

Common clays are mined to manufacture tile, pipe, and bricks and to provide an aluminum source for the manufacture of cement. Volcanic cinders are mined for aggregates, landscaping, and road deicing. Slag from a copper smelter is processed for roofing granules and abrasives. Pumice is used for fabric treatment and lightweight aggregate. Stone is quarried and crushed for

aggregates and landscaping. Decomposed granite is used for landscaping. Gypsum is mined and processed for wallboard manufacture, cement manufacture, and agriculture. Hematite is mined for color and barrier pigments. Sandstone is quarried and worked for flagstone. Schist, limestone, marble, rhyolite, gneiss, and granite are quarried for decorative stone.

Two new industrial mineral producers finished construction and development activities in 1999 for two commodities not produced in Arizona for decades. Applied Chemical Magnesias finished a \$2 million grinding and bagging plant at Bullhead city to process brucite from the underground White House mine located in the San Francisco district of Mohave County. Brucite, a magnesium hydroxide, will be used for waste water treatment and smoke and flame retardant functional fillers in plastics and coatings. AZCO Mining, better known in Arizona for their previous copper activities, developed the Black Canyon (aka Mica Mule) pegmatite located 30 miles north of Phoenix. It will supply mica for a dry classification and wet grinding facility in Glendale. The ground muscovite will be marketed for functional fillers and strengtheners for industrial coatings, plastics, and cosmetics.

Omya (Pluess Stauffer) of Lucerne Valley, California broke ground in June for their \$30 million calcium carbonate processing plant at Superior in Pinal County and is projecting a startup date in June, 2000. Of the 100,000 ton per year capacity two-thirds will be for food grade CaCO_3 additives. Their Queen Creek Limestone mine is continuing to supply mine-run white marble to Mineral Development Inc.'s crushing and screening plant at Queen Creek in Maricopa County. They are in the process of obtaining a new mining plan of operation from the Tonto National Forest for expanded operations at the mine.

Mineral Development Inc. has reported acquisition of property for a new white marble crushing and screening plant to be constructed near Omya's plant in Superior. The plant will replace the company's current facilities at Queen Creek.

Arizona Portland Cement is continuing with their capacity expansion at their Rillito cement plant. When completed in 2003, the plant's capacity will be increased to 2,300,000 tons of cement per year. The initial phase will increase capacity to 1,560,000 tons per year and involves installing a new raw feed roller mill and converting the existing raw feed mill into a finish mill. The second phase requires installing a second pre-calcining tower.

Phoenix Cement Company continues with their planning stage for plant modernization at their Clarkdale operation. Plans include an increase in plant capacity from the current 630,000 tons of cement per year to 1,100,000 tons per year. Phoenix Cement Company is wholly owned by the Salt River Pima - Maricopa Indian Community.

The booming economy is also favorably impacting the flagstone stone industry. The Drake and Ashfork area's sandstone quarries and dressing plant's in Yavapai County are operating at near capacity. Existing and new operators are continuing to open new quarries, bring idle quarries back into production, and upgrade processing and transportation facilities. Many of Arizona dimension stone producers are family owned smaller operations.

Gemstones

Arizona is a leading state in the value of mined gemstones in the United States. Approximately \$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 Native American jewelry. Contractors at a few of Arizona porphyry copper deposits mine it as a by-product. The best quality material is sold by the piece, and the remainder sold or processed for sale by weight. By-product turquoise is produced by Sleeping Beauty Turquoise from the Sleeping Beauty Mine at Pinto Valley. Colbaugh Processing terminated their turquoise mining agreement at the Mineral Park Mine in June and processes only purchased material. Although long known for their turquoise, the Morenci Mine and the deposits at Bisbee are currently yielding very little.

Peridot, the gem variety of the mineral olivine, 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. This deposit accounts for approximately 90 percent of the world's production.

Amethyst from the Four Peaks mine in Maricopa County has been coveted by lapidaries and collectors since the turn of the century. The best quality Four Peaks material is as good as any in the world. Kurt Cavano and Jim Machlan purchased the mine, inactive for over 10 years, in late 1997. The amethyst is mined by hand, flown by helicopter to Mesa (the property is surrounded by the Four Peaks Wilderness Area), and shipped to Bangkok for faceting.

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.

Government News

The Clinton administration has closed additional areas in Arizona to possible development of mineral resources. In January 2000 the administration created two new National Monuments in areas of known mineral resource potential. They are the Agua Fria National Monument east of I-17 in southeast Yavapai County and Shiviwits National Monument north of the Colorado River in Mohave County. Both monuments were created by Presidential Order without the oversight of Congress or public hearings. One reason stated for their declaration of National Monument status protection for the areas was to prohibit possible mine development of future valuable mineral resources.

The Arizona State Land Department has begun mineral evaluation programs for copper and sand and gravel occurrences on State Trust Lands in a thirty-mile perimeter around the Phoenix - Casa Grande - Tucson development corridor. The study is to provide the Land Department with

information that will assist them in maximizing revenue from the Trust Lands that may be subject to eventual preservation related to "growing smarter initiative" and the "Arizona preserve initiative."

Thanks to the cooperation of many county, state, and federal agencies the Arizona State Office of the BLM produced the *Arizona Mining Summit, Guide to Permitting Mining Operations*. This publication makes an excellent scoping document as it includes each permitting agency's authorizing statutes, estimates of the cost and time to acquire permits, as well as providing contact information.

Recreational Mining

Gem material, mineral specimens, and fossils collected by the rockhound and small contractors at the mines are not generally included in the reported gemstone production. It is likely that the value of this production is higher than that officially reported for gemstone production. Some portion of rockhound-collected material goes directly into collections, however, much of it and most of the other material collected is 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 dealers and buyers 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.

Another segment includes gold panners and operators of small suction dredges. Although gold is recovered by nearly all who participate, the recreational value is undoubtedly greater than the value of gold produced. Economic data for recreational mining is difficult to quantify, but the impact on the Arizona tourism industry is significant.