



Arizona Department of Mines and Mineral Resources

1502 West Washington, Phoenix, AZ 85007 Phone (602) 255-3795
1-800-446-4259 in Arizona FAX (602) 255-3777 www.admmr.state.az.us

ARIZONA MINING UPDATE – 2000 and 2001

Circular No. 100, November, 2002

By K.A. Phillips, N.J. Niemuth, and D. Bain

Arizona's 2000 mineral production value was \$2.8 billion and the estimate for 2001 is \$2.5 billion. Arizona accounted for more than 65 percent of the U.S. copper production, leading the Nation in the production of this commodity as it has for decades. 2000/2001 proved to be a mixed period for Arizona mining. A growing population and expanding infrastructure continued to increase demand for construction minerals. The value of these industrial minerals produced in 2000 is estimated to be \$679.0 million and \$693.3 million in 2001. The bad news occurred in Arizona's largest and most important mining segment, the copper industry, which was negatively impacted by concerns about energy supplies and was hit especially hard by lower copper prices. Copper represents about 70 percent of Arizona's total nonfuel mineral production value.

In 2000 Arizona was the leading state in molybdenum production, second in gemstones, third in crude perlite, fourth in construction sand and gravel, silver and zeolites, fifth in pumice and pumicite, sixth in iron oxide pigments, seventh in bentonite, and eighth in crude gypsum and dimension stone. There are 78 mining companies operating 160 mines in the state, with an additional 60 sand and gravel producers operating 160 pits and plants. The mining industry directly employs approximately 9,000 people in Arizona.

COPPER

Arizona's copper industry contracted significantly as the industry struggled to survive near record-low copper prices (in constant dollars), growing commodity warehouse inventories resulting from the slow global economy and the US recession, the tight regional energy market, and the impacts to consumption from the events of September 11.

The average copper price decreased \$.11 to \$.77 per pound in 2001, a decline of 8 percent from 2000. During the fall the copper price reached a 14-year low of \$.60 per pound. In November 2001, the price jumped about 10 cents as Phelps Dodge, Asarco and others announced new production cutbacks and even Chilean government-owned Codelco reported it was considering cutbacks for 2002. With other producers around the globe also reducing production there was some hope that huge inventories would not hang over the market for a long period.

Arizona's production declined 8 percent in 2001 and has dropped nearly 30 percent since the year of peak production, 1997. Monthly employment figures over the 5-year period fell from a peak of 11,400 to 6,500 at year's end, a 43 percent drop. It is anticipated copper production will drop further. Effective in early 2002, of Arizona's seven major mines, one will close and three will operate at less than 50 percent of capacity. Despite the decline, Arizona still accounts for 65 percent of primary US copper production. Additionally, when prices do rebound Arizona mines, with their extensive resources and highly-skilled miners will be ready.

Asarco Inc.

(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, and the Hayden copper smelter. Ray is the second largest copper mine in Arizona.

In 2001 Grupo Mexico moved its Asarco subsidiary's headquarters to Phoenix. About 100 former corporate New York and Tucson copper staff now work in Phoenix while more than 100 employees remain in Tucson. This move places the headquarters of two of the world's largest copper producers in Phoenix.

Ray

BLM approved, but has not yet completed, a land exchange with Asarco that will allow expansion of Ray's tailings, and allow future development of Copper Butte,

Table 1. Arizona commodity ranking in the US - 2000

Ranking in US	Commodity
1st	Copper
1st	Molybdenum
2nd	Gemstones
3rd	Perlite
4th	Sand and gravel, construction
4th	Silver
4th	Zeolites
5th	Pumice
6th	Iron oxide pigments

Buckeye and Chilito deposit, the Ray mine and the Hayden Limestone deposits. Asarco will trade 7,300 acres in Pinal and Mohave counties for 10, 976 acres in Pinal and Gila counties. Lands the BLM will acquire are riparian habitat and areas within or adjacent to wilderness areas. The exchange has not been completed as BLM is trying to resolve a protest.

Copper output at the Ray mine was 304 million pounds in 2000, and 352.5 million pounds in 2001. Ray also produced 684,000 oz of silver in 2001. Ray consists of an open-pit mine, dump and heap leach operations, a 102-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.

Mission

Mission's copper production in 2000 was 189 million pounds, down from 200 in 1999, and was 138.9 million pounds in 2001. Mission also is a significant silver producer, producing 1,562,000 ounces in 2001.

The Mission complex consists of the underground and open pit mines including Mission, Eisenhower, Pima, Mineral Hill, South San Xavier and the nearby San Xavier mine. The impressive Mission Pit is over 2.5 miles long, 1.5 miles wide, and 1,200 feet deep. Sulfide ore is treated at two mills, Mission and South, with a combined capacity to process 63,000 tons of ore daily, although currently processing 24,000 tpd.

In October 2000, Asarco announced that Mission's open pit mine plan would change to increase stripping

over higher-grade areas and reduce production of ore from 62,000 to 41,000 tpd while material moved will increase 25 percent. The changes will also extend mine life 14 to 22 years and increase ore grades and mill recovery, but copper in concentrate will decline by 48 million pounds per year. Helping keep the mill grade higher is the underground's daily contribution of 3,000 tons of 1.4 percent or better grade copper. Underground reserves total 7.5 million tons. Asarco reported it continues to search for options to achieve profitable production. These include negotiations with unions and vendors as well as finding ways to reduce the impact of higher energy costs and mineral royalties.

In November of 2001 Asarco announced production curtailments of 23 percent, effective January 1, 2002, the second curtailment in 4 months. Since November 2000 production has been reduced 61 percent. The South Mill was put on care and maintenance at the end of 2001. In August 2001 Asarco laid off 110 of its 625 employees at Mission and then 50 more in July 2002.

Hayden

The Hayden smelter, an INCO flash furnace rated at 720,000-tons-of-charge per year produced 438,308,000 pounds of copper in 2001 (a record output) and 571,800 tons sulfuric acid. Anodes produced at the smelter are shipped to the Amarillo Copper Refinery.

Silver Bell

Silver Bell produced over 40 million pounds of SX-

Table 2. Arizona Mineral Production

Short tons unless otherwise noted

Commodity	2000 ¹ Quantity	2000 ¹ Value	2001 ⁵ Quantity	2001 ⁵ Value
Copper	1,024,000	\$1,810,000,000	965,000	\$1,470,000,000
Gemstones	na	2,920,000	na	2,670,000
Gold (troy oz)	w	w	w	w
Molybdenum (lb)	w	w	w	w
Sand & gravel				
Construction	65,477,000	304,000,000	62,391,000	294,000,000
Industrial	w	w	w	w
Silver (troy oz)	4,244,000	21,200,000	w	w
Stone, crushed	8,852,000	48,200,000	7,716,000	43,300,000
Dimension Stone ⁴	340,000	44,000,000	380,000	51,000,000
Gypsum ⁴	1,100,000	16,000,000	1,200,000	18,000,000
Other ²	na	315,100,000	na	345,900,000
Coal ³	13,111,000	315,000,000	13,418,000	322,032,000
Total		\$2,876,420,000		\$2,546,902,000

1 USGS Preliminary figure

2 Includes cement, clay, lime, gypsum, molybdenum, perlite, salt, dimension stone, zeolites, and iron oxides.

3 ADMMR estimate for value

4 ADMMR estimate for quantity and value

5 Unpublished U.S. Geological Survey (USGS) data, subject to change; official USGS preliminary 2001 data will be published by USGS in the USGS *Mineral Industry Survey*, Arizona 2001 Annual Estimate.

(w – withheld)

EW copper in 2000 and 41.9 million pounds in 2001. Silver Bell includes three open pits, North Silver Bell, El Tiro, and Oxide. North Silver Bell mines ore using the conventional blast, load, and haul method for leach ore. El Tiro and Oxide are mined with a technique called rubblization in which areas planned for rubble leaching are drilled, blasted, and sprayed with acid to begin leaching.

In June 2001 Asarco asked the BLM to consider a land swap that would resolve the problem of 400 acres of Asarco's operations being included within the Ironwood National Monument.

BHP Copper

A merger of Billiton and BHP was announced in March of 2001. The merger created the world's second largest mining and metals company, valued at \$29 billion. BHP shareholders will emerge with 58 percent of the enlarged group and will be run from Melbourne, BHP's base.

In April, 2001, a joint venture was announced for BHP's Magma Porphyry discovery, also called Resolution Copper, that would allow Kennecott to earn a 55 percent interest by spending \$25 million over 6 years.

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.

San Manuel

San Manuel produced 23 million pounds of copper from its in-situ leach operation in the year 2000 and 20.5 million pounds in 2001. San Manuel consists of a block-caving underground copper mine, a 62,000-ton-per-day concentrator, in-situ leach and a 60,000-ton-per-year SX-EW plant.

It was announced in January 2002 that the in-situ operations would close. Underground mining ceased in August 1999. Sadly, the only recently developed Lower Kalamazoo orebody, with its estimated ore reserves of 2.5 billion pounds of contained copper will not be mined.

BHP's San Manuel smelter is the largest single furnace smelter in the industry at 1,300,000-ton-per-year. There is also a 3,000-ton-per-day acid plant, a 690-million pounds-per-year electrolytic refinery, and an 180,000-ton-per-year rod plant. The smelter was shut down 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,

Table 3. Arizona Copper Production – 1997-2001
Cu (million lb.)

Mine, Company	2001	2000	1999	1998	1997
Morenci, Phelps Dodge and Sumitomo	783.2	834	960	1,046	1,084
Ray, Asarco	352.5	304	318	335	304
Sierrita, Cyprus (PD late 2000) ²	241.8	245	204.5	226	246
Bagdad, Cyprus (PD late 2000) ²	257.2	247	211.2	215	246
Mission, Asarco	138.9	189	200	255	252
Miami, Cyprus (PD 2000) ²	88.2	137	124.2	164	156
Silver Bell, Asarco and Mitsui	41.9	40	46	42	19
Pinto Valley, BHP ¹	32.0	38	na	37	157
San Manuel, BHP ¹	20.5	23	na	271	251
Tohono, Cyprus (PD late 2000)	0	0	0	8	27
Mineral Park, Equatorial Mining	3.6	5.0	inc	inc	3
Other	na	na	na	6	2
Total	1,959.8	2,062	~2,300	2,605.4	2,747

Data from company annual reports, form 10-ks, etc.

na - not available inc. – included with other

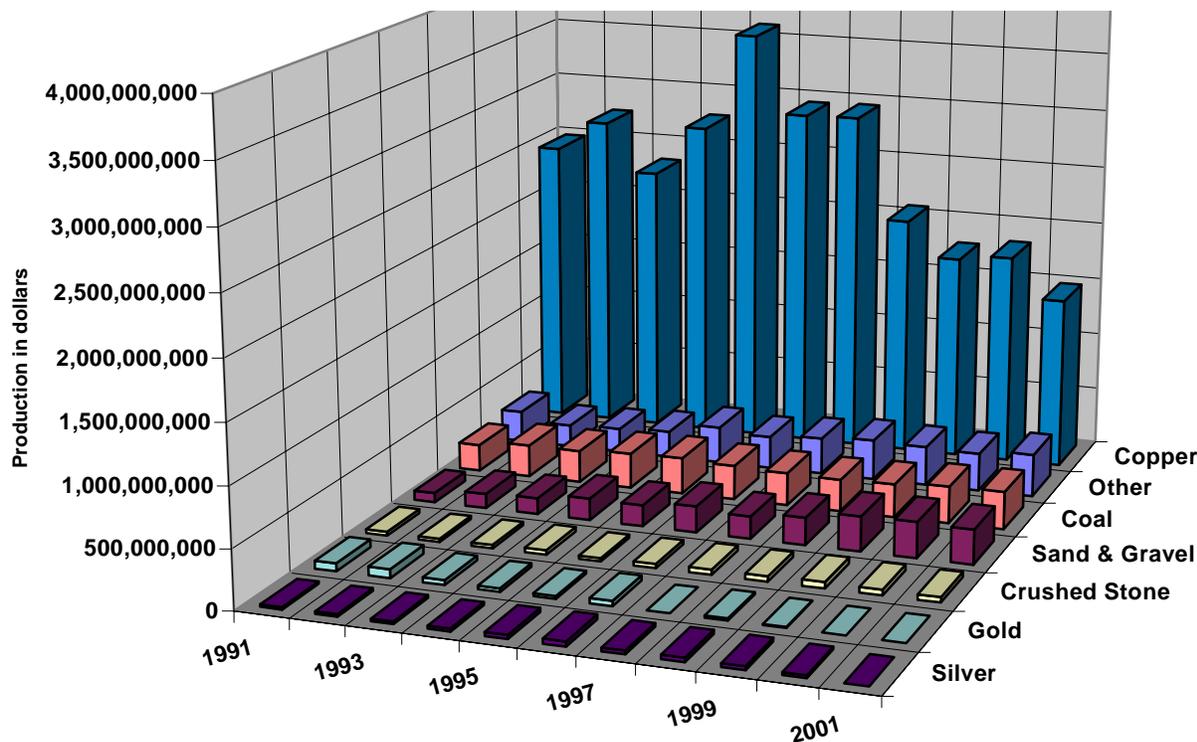
1. June 1, - May 31, annual basis for 1997 and 1998

2. Production data for Oct. 1-15, 1999 is unreported.

Kennecott began a planned 18-month drilling campaign on the deep but high-grade deposit. The deposit, deeply buried under post-mineral rocks, was first intersected by drill holes from the underground workings of the Magma mine in 1995. The top of the deposit is approximately

and improving the conveyor systems to reduce spillage and airborne contamination. These changes increased the flash smelter volume and, when operating, would result in lower SO₂ emissions. The project was completed but the smelter did not restart due to the mine closure.

Figure 1 Mineral Production 1991- 2001



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. In early 2001 hydraulic mining/leaching of the #2 tailings. was completed. In-situ leaching at Miami continues. Pinto Valley produced 38 million pounds of copper in fiscal year 2000 and 32 million pounds in 2001.

Miami's operations recover copper from in-situ leaching of the old Miami mine block cave area. 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.

Florence

Florence was sold by BHP to Vanguard Property, a real estate firm doing business as Florence Copper. The 5,500 acres reportedly sold for \$14 million.

Phelps Dodge Corporation

Phelps Dodge is 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. Phelps Dodge is also the world's largest molybdenum producer.

In early 2002, Phelps Dodge moved into its new corporate headquarters in the newly constructed Phelps Dodge building at One North Central in downtown Phoenix. Phelps Dodge will anchor the building, occupying over half the office space.

The company's Morenci mine in Greenlee County is the largest copper mine in North America. 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 controls significant undeveloped copper resources throughout the state, including several deposits near Safford and the New Cornelia mine at Ajo. They also operate Bagdad, Miami, and Sierrita mines, acquired from Cyprus in 1999.

Morenci

Morenci is the fifth largest copper mine in the world and the largest copper mine in North America. It had an annual production of 834 million pounds in 2000 and 783.2 million pounds in 2001.

The Morenci operation consists of the Metcalf and Northwest Extension open-pit copper mines, four dump leaches with four SX plants, and three electrowinning tankhouses. The new Southside EW plant has an annual capacity of 150 million pounds, Morenci is the worlds largest EW plant, with an annual capacity of 370 million pounds, and the newest plant, Stargo, built in 2000, has a 240 million pound capacity. In the late Fall 2000, heavy rains caused an interruption in mining, diluted the leach solutions and resulted in a loss of 20 million pounds in production.

For the first time in nearly 60 years there is no concentrator operating in the Morenci district. The Morenci concentrator closed at the end of February 2001, after having operated continuously since February 1942. A \$220 million construction project, which included

crusher modifications, mobile conveyors, stackers, and leach and SX-EW facilities, was completed in March 2001 allowing Morenci to convert to an all-leach operation. Morenci is the world's largest producer of copper cathode from SX-EW.

A major drilling program during 2000 delineated deposits north of the Morenci mine. Garfield contains a resource of 1,750 million tons grading 0.27 percent copper.

Morenci's milling reserves totaled over 128.7 million tons grading 0.41 percent copper, while crushed leach reserves totaled over 468.8 million tons of 0.60 percent copper and dump leach reserves 2,853 million tons of 0.22 percent copper at the end of 2001.

Sierrita

Sierrita produced 245 million pounds of copper in 2000 and 241.8 million pounds in 2001 and is the largest molybdenum producer in the state.

The Sierrita property consists of an open-pit copper-molybdenum mine, 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. At the end of 2001 Phelps Dodge reported Sierrita contains sulfide reserves of 1.052 million tons grading 0.27 and leach reserves of 62.5 million tons grading 0.19 percent copper.

After dispelling closure rumors in the spring by announcing plans to invest \$13 million to improve the mine and mill at Sierrita, in January 2001 Phelps Dodge announced it might be forced to lay off 740 workers. A cutback of 50 percent was announced in November of 2001, effective January 2002. High-energy prices and energy disruptions due to the California electric crisis along with low molybdenum prices, in addition to low copper prices, are to blame.

Bagdad

The Bagdad mine in Yavapai County produced 247 million pounds of copper in 2000 and 257.2 million pounds in 2001. A cutback of 50 percent was announced in November of 2001, effective January 2002.

Phelps Dodge reported at the end of 2001 that Bagdad had a 884.9 million ton sulfide reserve of 0.36 percent copper, as well as 17.7 million tons of leach material of 0.29 percent copper.

Phelps Dodge also announced it would begin construction of a \$40 million copper concentrate leaching demonstration plant at the Bagdad Mine in the second

Table 4. Value of nonfuel mineral production per capita and per square kilometer in 2000

	Arizona	US Total or Average
Total Value (thousands)	2,510,000	39,400,000
Population (thousands)	5,310	284,000
Per capita \$ (ranking)	474 (6th)	139
Area (sq. kilometers)	295,000	9,370,000
Per sq. kilometer \$ (ranking)	745 (11th)	4,200

quarter of 2002. The plant is designed to recover commercial-grade cathode copper from chalcopyrite concentrates. The facility will be the first of its kind in the Western Hemisphere.

When completed in mid-2003 the plant will process 150 tons per day of concentrate produced by the existing mill and flotation operation. At full capacity it is expected to produce 35 million pounds of copper cathode from concentrate annually, accounting for approximately 15 percent of Bagdad's total copper production capacity. If successful it could eliminate the need for smelting, with attendant economic savings.

Miami

The Miami operation 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. Miami produced 137 million pounds of copper in 2000 and 88.2 million pounds in 2001. At the end of 2001 Phelps Dodge reported leach reserves for Miami of 117.6 million tons grading 0.38 percent.

Phelps Dodge announced a mine and refinery closure effective January 2002, but with smelting of concentrates from Bagdad and Sierrita continuing.

Table 5. US and Arizona Copper Production and Prices

Year	US (metric ton)	Arizona (metric ton)	Arizona (billion lbs)	Change	Price cents/lb	Change
1998	1,860,000	1,190,000	2.600		78.6	
1999	1,600,000	1,050,000	2.314	-11%	75.9	-3.4%
2000	1,440,000	963,000	2.123	-8%	88.1	16.1%
2001 ^p	1,340,000	888,000	1.945	-8%	77.0	-12.6%

p) preliminary from USGS

Safford

The final EIS for Phelps Dodge's Safford leach project (San Juan and Lone Star deposits) was not published by the BLM in 2001. Although there had been hope that the change in administrations would speed the permitting, it was reported to be on regulatory hold while the BIA studies models of water flows beneath the nearby San Carlos Indian reservation. The planned open pit heap leach operation would produce 250 million pounds of copper per year by SX-EW.

Other Copper Companies

Equatorial Mining Limited's Mineral Park mine in Mohave County produced 5.0 million pounds of cathode copper in 2000 and 3.6 million in 2001. The sale of Mineral Park to Mercator Minerals awaits financing.

The Carlota leach project remains on hold, waiting for copper prices to improve. Cambior estimates it would take \$100 million to develop the mine and plant that could produce 70 million pounds of cathode copper at costs below \$.50 per pound.

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.

AMT's Copper Creek project was halted due to lack of funding for drilling and development.

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 a small amount 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 2000, Arizona's coal production was 13.1 million short tons and 13.4 million in 2001.. The Kayenta mine ranked as the 18th largest coal mine in the country with a production of 8.45 million tons. All production is from 64,858 acres of land leased from the Navajo Nation and Hopi Tribe by Peabody. The direct economic annual benefit to the reservation communities in the year ending March 1999, was more than \$100 million. These results included royalties, wages, benefits, and charitable contributions. The 30-year economic benefit totaled over \$1.8 billion by 1999.

In 2000, the latest year for which figures are available, Arizona coal reserves were at 102 million tons.

In 2001, the Kayenta mine operated more than 1 million employee hours without any accident causing an employee to miss work. In the same year Peabody Group was named 'best coal company' by an international panel

of judges. Coal companies were judged on safety, environmental concern, productivity, market/technology innovation and financial record.

High-quality, low-sulfur coal is strip mined from the Kayenta and Black Mesa mines in central Navajo County. The coal is sub-bituminous 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 next transport it 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.

Table 6. Arizona Coal Production

Mine	Rank in US 1999	Tons 1999	Rank in US 2000	Tons 2000
Black Mesa	46	4,483,260	43	4,625,345
Kayenta	21	7,251,024	18	8,485,952

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.

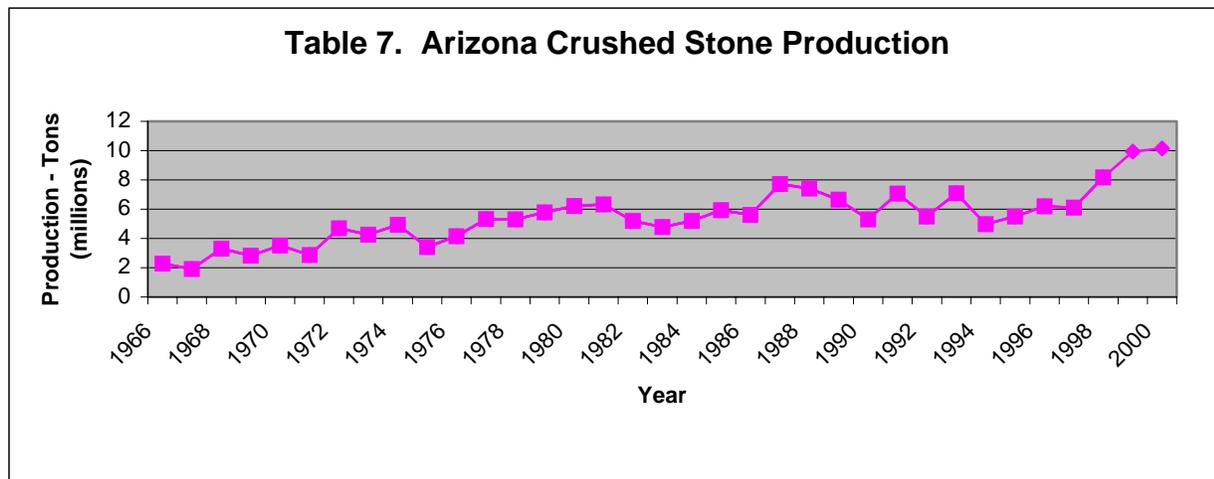
GOLD

Prices below \$300 per ounce have discouraged most exploration and production activities with one major exception. In the fall of 2000, American Bonanza Gold Mining Corp. began an underground development project at Copperstone in La Paz County to provide drill sites and possible extraction of a 50,000-ton bulk sample. The operation, a joint venture with the contractor Centennial Development's parent BLM Services Group, included a 2,000 ft. decline from the lower level of open pit.

INDUSTRIAL MINERALS

The economic importance of industrial minerals continues to grow. In 1999 Arizona industrial mineral production was \$548 million, only 19 percent of the state's total mine production. By 2001 the value of industrial mineral production had increased to \$693 million, or 27 percent of the state's total. This diversified sector's leading products are construction minerals; sand and gravel, cement, dimension stone, and crushed rock.

Table 7. Arizona Crushed Stone Production



Sand and Gravel

Rinker Materials Corporation has acquired Kiewit Materials Company, the 16th largest aggregates producer in the US. Kiewit operated in Arizona as United Metro Material, Inc. and will continue to use that name. This transaction continues the consolidation trend in the aggregate industry of the last decade. Including the Kiewit Materials operations, Rinker will be the fifth largest aggregates producer in the U.S.

In January 2001, Rockland Materials switched its entire fleet of ready mixed concrete trucks and mobile aggregate equipment to 100 percent soy-based (B100) biofuel. Operating about 120 heavy-duty diesel units, Rockland Materials is the only Arizona company to make a complete switch to biofuel. It also represents the largest commercial fleet in the United States to make the conversion. According to owner Grant Goodman, Rockland Materials will spend about \$300,000 more to run its fleet with a fuel consumption rate estimated at about 1.2 million gallons a year.

Vulcan Materials opened two new plants near Sun City, a hot asphalt plant and an aggregate processing facility costing \$7.5 million.

Cement

In 2000 Phoenix Cement announced plans for a \$105 million modernization of the Clarkdale cement plant. The upgrades include a new high-efficiency vertical roller mill, a low NOX kiln system for clinker manufacture, and an increased capacity of 400 tons-per-day.

The expansion project at the Phoenix Cement plant at Clarkdale will be completed before the end of 2002. Expanded capacity at the plant will be 1,100,000 tons of cement per year. The majority of the kiln fuel is coal from the National King Mine near Hesperous, Colorado.

Stirling Bridge Cement Company is continuing with their proposed 350,000 ton per year Portland cement plant at Drake north of Prescott. Current expectations are for the plant to be operational in January 2004. The proposed \$80 million cement plant is to be built on private land the company has acquired at Drake. Projected full-

time employment will be between 75 and 100. Maximum employment during construction will be about 220. The plant will produce Type I/2 Portland cement. Limestone for the plant will be produced at the at the previously quarried Cedar Glade limestone quarry. The proposed quarry lies within the Prescott National Forest

Activity at the quarry and plant site began in October 2000 with the location of mining claims and the purchase of private land for a plant site. The limestone deposit was drilled in the summer of 2001 and sufficient reserves were proven to supply 550,000 tons of limestone per year for the projected 70-year life of the cement plant.

Rockland Materials, a Phoenix area sand and gravel and ready mix concrete producer, would likely consume a large portion of the cement production as the two companies have a common owner.

Evaporates

Copper Eagle Gas Storage LLC, an affiliate of Pinnacle West (APS's parent), conducted drilling on the Luke Salt deposit west of Phoenix to investigate a possible gas storage facility.

Aquila, a subsidiary of UtilCorp United purchased a 36,000-acre ranch covering a portion of the Red Lake evaporite basin in Mohave County north of Kingman. It plans to build a 12 billion cu ft gas storage facility that would connect to El Paso and Transwestern gas pipelines.

U.S. Borax conducted exploration for evaporites in the Verde Valley. In the same area drilling by Arizona Department of Transportation recently identified a lens of thenardite in the Camp Verde formation near the AZ 260 and I-17 interchange.

Clay

Common clays are mined to manufacture tile, pipe, and bricks and to provide an aluminum source for the manufacture of cement. Bentonite is mined for out-of-state processing into desiccants and for bleaching and clarifying of edible oils.

Crushed Stone

Stone is quarried and crushed for aggregates, rip rap, and landscaping. Decomposed granite is used for landscaping.

The Crushed Stone Industry Grows Up, A History of Mineral Trespass on Public Lands in Central Arizona, by Scott Donaldson, a Phoenix mining attorney, has been released by the Department as Open-File Report 02-18. The report is a discussion of the details of specific cases involved in the fascinating and lengthy litigation battles between the BLM and the crushed stone producers in Maricopa County.

Dimension Stone

Silver Arrow Stone Company is a new dimension stone company located in Fredonia. The principals, Roger Smith, President and Larry Casebolt, Vice President, were formerly with Arizona uranium mining operations for Energy Fuels. Their stone yard and plant are located at the former IUC site in Fredonia. Silver Arrow is quarrying building stone from sedimentary rock deposits at various locations on the Arizona Strip.

Other additions to the dimension stone producers include: Mortimer Stone, Hammond Wholesale Stone, Horner Stone, Howard Grey Stone, and Stone World. Seventeen dimension stone producers are listed in the directory. Sandstone cut and split into flagstone is the predominate product of these mining operations.

It is estimated that Arizona's sandstone-flagstone industry's annual production is 380,000 tons per year with an estimated mine value of \$51,400,000. Official production data is very limited. The seventeen dimension stone producers listed in this director employ 690 workers.

Gypsum

Arizona's expanding cement production caused a corresponding increase at the gypsum mines that supply the retarder mineral to the cement companies. Both United Metro Materials' Winkleman Gypsum mine and Phoenix Cement's Verde Gypsum mine are expanding to fill the almost-doubled demand for gypsum. United Metro supplies gypsum to the Arizona Cement Company plant at Rillito and Verde Gypsum supplies its parent company's cement plant at Clarkdale.

Western Gypsum was acquired by the James Hardie Industries in 2000 and renamed Western Mining and Minerals. James Hardie Industries was one of the large manufacturers of gypsum wallboard makers in the USA. In the first quarter of 2002 British Plaster Board (BPB), the world's largest manufacturer of gypsum wallboard bought the three wallboard plants owned by James Hardie Industries and their Western Mining and Minerals gypsum mine near Littlefield Arizona south of St. George, Utah.

Current gypsum production at Western Mining and Minerals is reported to be 700,000 tons per year. This is more than the current combined total of the Arizona's other five producers. Western Mining and Minerals reports plans to double capacity to 1,400,000 tons per year

by the end of 2004. Essentially 100 percent of Western's production is consumed outside of Arizona. Gypsum wallboard manufacture and Portland cement production in the Las Vegas area are the major consuming markets.

Pumice

Pumice is used for lightweight aggregate. More than 15 years of mining pumice came to an end on March 1, 2001, when Phoenix based Arizona Tufflite accepted a \$1 million payment from the federal government to quit fighting for approval for a new plan of operations from the Forest Service and shut down its small open-pit White Vulcan Mine 12 miles of Flagstaff. The sell-out and agreement to stop mining was the culmination of years of environmental group activists' efforts to get Native Americans to stop mining in the region. The San Francisco Peaks, 14 miles to the northwest are considered a sacred site by some members of Indian Tribes. The buy-out included provisions for reclamation and 10 years of shipping from pumice stockpiles at the mine site.

Other Industrial Minerals

These minerals are a diverse group and include limestone and marble, cinders, smelter slag, zeolites, crushed stone, decomposed granite, boulders, 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. 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.

GEMSTONES

Arizona is the 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. Rockhound hobby production is purported to add over \$2 million in value that is not included in official reports. 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.

Turquoise has recently moved from the niche market to upscale, mainstream markets when some famous film stars starting adorning themselves with turquoise jewelry. The resulting frenzy in the turquoise industry delighted and exhausted Arizona producers. 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 rivals 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, Thailand 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

In October, 2001 the Interior Department's Bureau of Land Management (BLM) issued new mining regulations that removed the controversial provision giving the Interior Secretary authority of prohibit new mine sites. The '3809' surface mining regulations, which apply to hard-rock mining on public lands, retain the strict bonding requirements that the Clinton administration added in the last days of office.

The Arizona State Land Department made changes in the Arizona Revised Statutes §37-205 to provide for the reimbursement of some expenses incurred by a non-successful bidder who originally applied for the material sale and who incurred certain expenses in that application process. The text reads, "If the successful bidder at the auction is not the applicant, the successful bidder shall reimburse the applicant for fees and costs paid pursuant to this section in amounts and on terms as the commis-

sioner or the commissioner's designee directs in the auction notice. After reviewing the reimbursement amounts, the commissioner shall remit them to the applicant."

Some examples of costs for which reimbursements may be made are: cultural resource investigations, legal land surveys, environmental assessments and economic consulting, engineering, planning, legal or geological studies.

Additionally, reimbursement may be given by the Land Department if an auction does not occur as a result of a mistake or circumstances caused by the Department, including issues arising out of concerns over title, misidentification of the parcel and factors affecting the commissioner's view of the timeliness or desirability of disposing of the parcel.

The Arizona Corporation's Securities Division accused Xenolix Technologies Inc. of fraud in a stock promotion. The company had previously been known as Mariah International, Guildmark Industries and M.G. Gold Corporation. The commission alleged that the company had made unregistered offerings of stock at a time it was claiming, "to have a patented technology that would extract gold and precious metals from the company's volcanic cinders property." The company agreed, along with other terms, to buy back shares from investors from placements made between 1997 and 1999.

**Table 8. National Monuments
Created in Arizona
2000 through January 2001**

Monument	Acres	Date
Grand Canyon Parashant	1,054,264	1/11/2000
Agua Fria	72,544	1/11/2000
Ironwood Forest	189,731	6/9/2000
Vermillion Cliffs	293,000	11/10/2000
Sonoran Desert	496,337	1/17/2001
Total acreage in Monument	2,105,876	
BLM land lost to mining !	1,695,559	
Arizona state lands included	93,543	

In a period of just over a year, January 2000 - January 2001, five new national monuments were created in Arizona, totaling over 2 million acres! Three of the monuments were created in areas of known mineral resource potential, the Agua Fria, Grand Canyon-Parashant, and Ironwood by Presidential Order without the oversight of Congress or public hearings. In fact one reason given for their National Monument status protection was to prohibit possible mine development of future valuable mineral resources. Mountain States Legal Foundation filed suit in Federal Court on August 30, 2000 challenging the legality of the new monuments. The lawsuit has been amended to include the Sonoran Desert Monument. In early 2001 Secretary of Interior Norton announced that the Bush administration would not seek

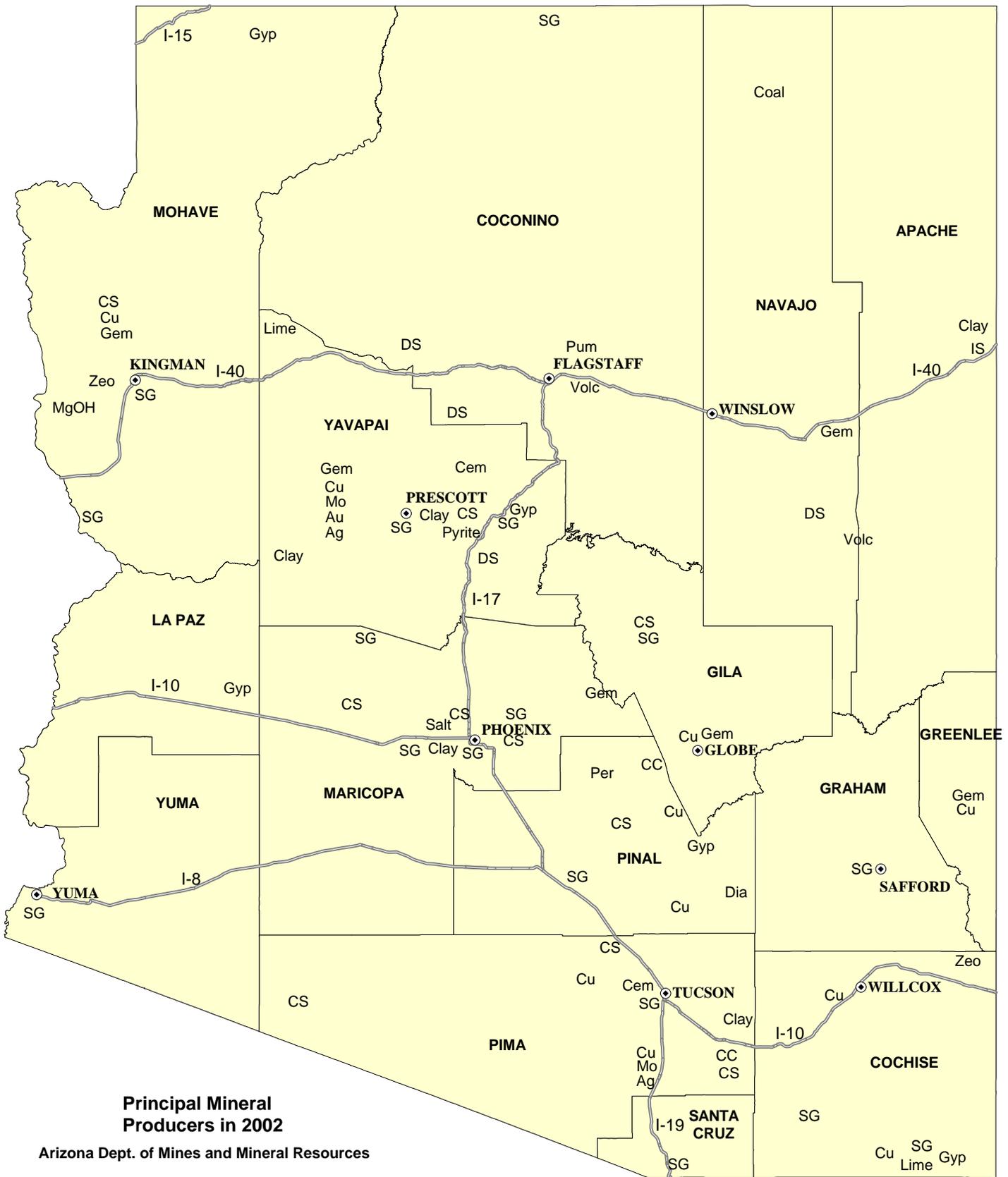
to overturn the new monuments. In November Mountain States' legal challenge was denied by the Washington D.C. Federal District Court, however an appeal is planned.

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.

In 2000 the Tucson gem shows generated \$76.5 million for the Tucson area. The State and local governments collected \$5.98 million in sales taxes for the shows. The gem show in Quartzsite, for example, is the largest in the world, drawing in excess of 100,000 visitors. More than 25 additional gem shows are held in the state annually and 37 organized earth science clubs are currently active. More than 25 additional gem shows are held in the state annually and 37 organized earth science clubs are currently active.

Another segment of recreational mining 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.



- | | | | |
|------------------------|----------------------|-----------------|--------------------|
| Ag - silver | CS - crushed stone | Lime - lime | Pyrite - pyrite |
| Au - gold | Cu - copper | MgOH - Brucite | Salt - salt |
| CC - calcium carbonate | DS - dimension stone | Mica - mica | SG - sand & gravel |
| Cem - cement | Gem - gemstones | Mo - molybdenum | Volc - cinders |
| Clay - clay | IS - industrial sand | Per - perlite | Zeo - zeolite |
| Coal - coal | Gyp - gypsum | Pum - pumice | |