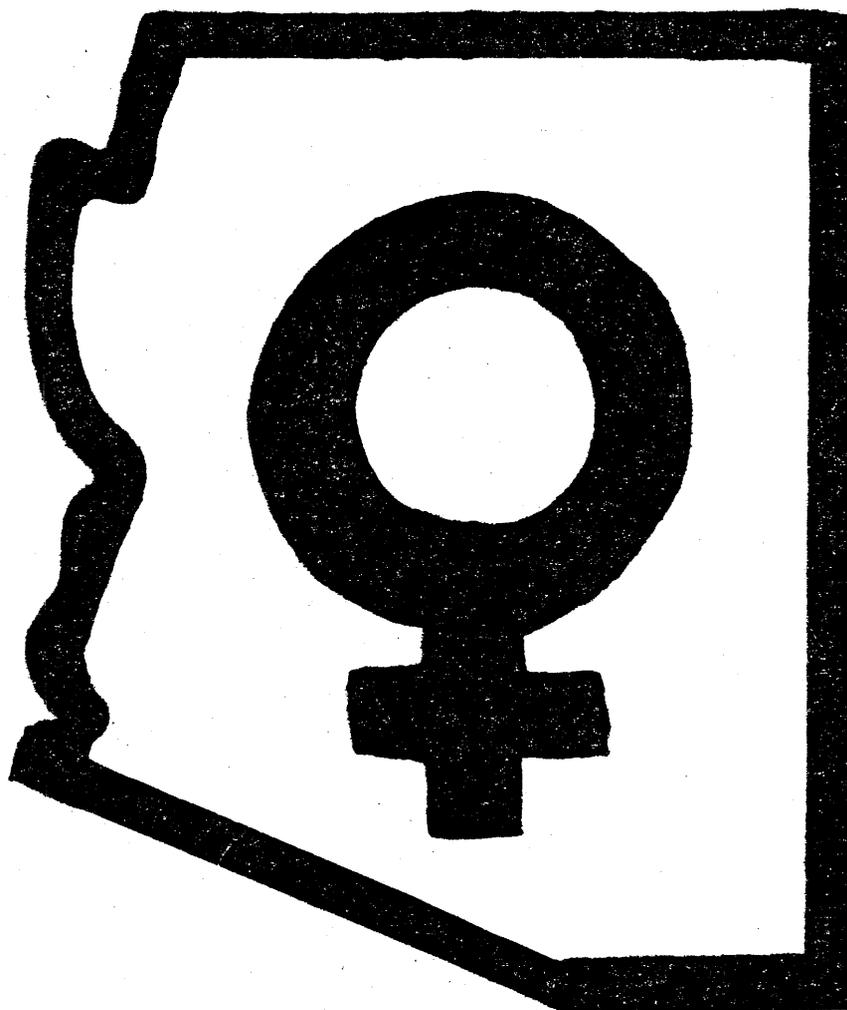


THE PRIMARY COPPER INDUSTRY
OF ARIZONA
IN
1977 - 1978

SPECIAL REPORT NO. 3



BY

MICHAEL N. GREELEY

ARIZONA DEPARTMENT OF MINERAL RESOURCES

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ARIZONA DEPARTMENT OF MINERAL RESOURCES
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1/ Throughout this report a "Ton" means a short ton (2000 pounds or 1.1023 metric ton).

INTRODUCTION

The Arizona Department of Mineral Resources presents herein a report on the copper industry. This report profiles Arizona's copper production during 1977 and 1978. A short resume of the operational highlights reported by individual developers and producers in the state is also given.

The statistical tables in this report include various production and employment figures through 1978. In addition, the tables include historical compilations of leach-copper as a percentage of primary production, average grade of ore produced, recoveries, stripping ratios, and designed copper capacity. A table and location map of copper reserves in Arizona is also provided.

The Department maintains an extensive library of information concerning the copper industry, including earlier editions of reports similar to this one. A supplement to this edition, containing national and international copper statistics and discussing economic conditions of 1977 and 1978, will be issued at a later date.

COPPER PRODUCTION IN ARIZONA

The center of copper production in the United States is Arizona. In 1977 the State accounted for 61.4% of the Nation's newly mined copper. In 1978 Arizona produced 979,548 tons of the red metal, slightly less than the record-setting level of over one million tons in 1976, and accounted for 65.7% of the total primary production in the U.S. (Table XI). This percentage of U.S. production is the highest ever attained by the State and it emphasizes dramatically the position and role Arizona plays in supplying a vital resource to the country's industry and economy.

In 1978 the gross value of mineral production, excluding coal, natural gas, and petroleum, in Arizona was \$1,680,172,000. Of this total value, copper production contributed 78% (Table VII). Other major contributors to the total mineral production of the State include molybdenum, gold, and silver. Virtually all the molybdenum and most of the gold and silver are byproducts of the treatment of copper ores (Table VI). As a result, Arizona ranks second in the United States in the production of molybdenum and silver, and fourth in the production of gold.

Eight mining properties combine to make Pima County the largest producer of copper in the State. These properties accounted for 38% of the total production in 1977 and 32% in 1978. Two of the mines were leaders in the State: Twin Buttes was the second largest producer in 1977 and third in 1978 while Sierrita was fourth both years. Pinal County, with five mining properties, was the second largest producer in Arizona.

Employment in the primary copper industry continued to drop significantly in 1977 and 1978 as the copper market worsened. From a record employment high in 1974 of nearly 28 thousand persons working in the industry, the average number of employees had fallen 24% to approximately 21 thousand in 1978 (Tables XII and XIII). Productivity figures and earnings during the 1977-78 period rose however. The production worker's average hourly production rate increased about 13% over the 1976 rate (from 5.4 tons/man-hr to 6.1 tons/man-hr). The worker's average hourly earnings rose roughly \$1.31 (from \$7.14/hr to \$8.45/hr).

There were 27 major Arizona copper mines producing in 1977 (Table I). The number of operating properties had been reduced to 23 by 1978. The dismal economic conditions that prevailed in the copper industry during this period forced the early closure of the Bruce mine and suspended ore mining at the Christmas, Esperanza, Ox Hide, and Pima mines in 1977. The Lakeshore mine was closed also in 1977 and eventually returned to its owner. No new production was initiated in the 1977-78 period.

Copper produced by leaching methods continued at a relatively high rate in 1977 and 1978 (Table II). Leach operations were maintained at the Esperanza and Ox Hides mines although ore extraction at these properties was suspended. Generally the cost of producing leach-copper has been less than producing milled sulfide concentrates.

Over the years the average grade of ore mined has declined. Between 1968 and 1978, the copper content of sulfide ores dropped 15% to a point where there was only about 12 pounds of copper in each ton of ore produced (Table III).

A review of the copper recoveries listed in Table IV indicates little or no change during the past decade. Although no attempt was made to weight the recoveries according to the amount of material treated, it is obvious that, for an operation to sustain its copper metal production with leaner ore feeds, significant technological refinements must have been made.

With the suspension of ore extraction at four mines, the number of open pit operations declined from 20 in 1977 to 16 in 1978. The stripping ratio, or the amount of waste removed in comparison to the amount of ore mined, at these operations is given for the past decade (Table V). Even though the average annual stripping ratio has not fluctuated greatly from what it was in 1968 (2.2:1), the ratio does appear to be creeping upward. The average ratio was 2.6:1 in 1977 and was lowered to 2:1 in 1978.

Table X shows an estimate of the capacity to produce primary copper at each of the State's principal operations. In total there is a designed capacity to produce slightly more than 1.25 million tons annually. The Arizona mines and their concentrators and leach-plant facilities operated at about 74% potential capacity during 1977. Despite approximately 14% reduction in operating capacity, due just to mine closure and suspensions, production in 1978 was raised slightly to about 78% of potential capacity.

Many factors, some of which have been discussed above, affect the actual production of copper in Arizona. Most technological factors are so interwoven that to isolate one and describe its impact is extremely difficult and often misleading. An even more difficult task is to properly evaluate the rapidly enlarging domain of socio-political factors that influence daily the decisions made by the developers and producers of copper. Foremost, however, in any discussion of capacity is the availability of the natural resource, in this case the availability of deposits of copper mineralization. A chart showing most of Arizona's rich endowment of proven copper reserves is given in Table XV.

An interesting development that recently improved the reserves held by ASARCO should be mentioned. In 1976 an agreement signed with Anamax effectively unlocked over 200 million tons of ore. In addition to the new Palo Verde mine containing 156.5 million tons that will be developed by the partners, ASARCO will extend the life of its Mission and San Xavier mines by adding to them 44.2 million tons. Moreover, there will be a significant improvement of ore grade at the Mission mine.

It should be emphasized that, although the reserves listed in Table XV total more than 10.5 billion tons of ore (generally as of December 31, 1978), the figures can move upward or downward drastically with changes in technological skill or with changes in U.S. policy or economy. If, for example,

socio-political factors such as capricious rules and regulations imposed by government become too burdensome, many of these deposits may never be developed and many of the existing mines may be closed. Arizona's and therefore America's capacity to produce copper will then be seriously harmed.

HIGHLIGHTS OF COMPANY OPERATIONS IN ARIZONA

The following is a resume of operational developments and accomplishments of major companies in Arizona concerned with production of copper.

Anamax Mining Company

Since completion, in 1976, of its expansion program, Anamax has continued to lead the State in the production of high-quality cathode copper in a solvent extraction - electrowinning plant. By the end of the 1977-78 period the company had increased cathode production 24% over the 1976 output. Production of 35,807 tons in 1978 was 99.5% of design capacity.

Because of poor economic conditions, however, the sulfide concentrator operated at levels far below capacity. A production schedule, approximately 60% of capacity, begun in 1976, was maintained until October 1, 1977, when the processing rate was further reduced to 40% of capacity. The rate was 46% of capacity in 1978.

Sulfide concentrator recoveries were increased over 1976 levels. The average recovery improved 28% in 1977 and declined slightly in 1978.

ASARCO Inc.

Normal production levels were maintained through June 1977 at the Mission, San Xavier, and Silver Bell mines. Beginning in July a ten-week strike, followed by a shutdown due to weak economic conditions, kept operations at these mines closed through October, when they were reopened on a curtailed basis. Although production of sulfide ore commenced at the North San Xavier mine, mining of oxide ore at the South San Xavier and operation of the vat-leach plant were put on standby. In the meantime, an engineering feasibility study was initiated to consider conversion of the leach plant to a facility capable of treating the San Xavier sulfide ores. The study indicated that conversion is practical and will be eventually economical.

The Sacaton mine operated normally during 1977 except for a shutdown period, because of weak copper markets and prices, from September 9 through October 29. Development of the underground Sacaton East orebody was resumed in July and the main shaft was advanced to a depth of about 1,200 feet.

In February 1978 full production resumed at the Mission, San Xavier, and Silver Bell mines. The oxide ore at the South San Xavier was exhausted and the leach plant was closed in November. Meanwhile, production of sulfide ore at the San Xavier mine and shipment to the Mission concentrator increased. The molybdenum recovery facility at the Silver Bell mine was reactivated in September.

A full seven-day-a-week production schedule was maintained throughout 1978 at the Sacaton mine and design capacity was exceeded by about 10%. Sinking of the main shaft on the Sacaton East deposit continued until April. At this time the shaft reached a depth of 1,474 feet and a temporary halt to the advancement was ordered because of high groundwater flow.

During 1977 operation of the company's smelter at Hayden declined to about 56% of effective capacity. This decline was due primarily to a ten-week strike and to unusual weather conditions that prompted operational curtailment to meet ambient air quality standards. In 1978 the smelter operated at approximately 65% of effective capacity. The installation of secondary exhaust hoods on the converter furnaces was begun during the year to reduce low-level emissions of sulfur dioxide.

Casa Grande Copper Company

Delineation drilling and engineering test work continued through 1977 and 1978 on the Casa Grande copper deposit. Metallurgical and chemical studies of drill cores were conducted in order to develop an initial economic flowsheet for processing the ore. The deposit is mineable by underground methods and should respond favorably to known treatment processes. The operation is managed by the Hanna Mining Company although the deposit is owned jointly by Hanna and the Getty Oil Company.

Cities Service Company

Daily production at the Pinto Valley mine and mill was increased in 1977 to 47,000 tons per day, 17% over design capacity of 40,000 tons per day. Mine production was stopped, however, from July until mid-September because of a 25-day strike and subsequent shutdown due to poor economic conditions. Leaching operations and production of copper precipitates and cathodes at the Copper Cities and Miami units were uninterrupted during the year.

Design modifications begun in 1976 at Pinto Valley to increase mine and mill capacity to 50,000 tons per day and to construct a new leaching and solvent extraction - electrowinning facility were suspended in 1977, pending improvements in the copper market. The development program on the Miami East underground mine remained on standby during the year also.

In 1978 production rates at Pinto Valley continued through the year 17% higher than the original designed capacity. This output, combined with the production at the Copper Cities and Miami units, resulted in a record of over 161 million pounds of copper produced by the company's operations in Arizona.

Plans for further expansion of copper production at Pinto Valley and Miami East were continued on standby pending additional project evaluation and improved economic conditions.

Continental Oil Company

Development of the company's Poston Butte deposit near Florence, Arizona, remained on standby during 1977 and 1978.

Cyprus Mines Corporation

Late in 1977 an expansion project was completed at Bagdad to provide capacity to increase annual copper production more than 300% over prior levels. In addition to the enlargement of the open-pit mine, a new 40,000 ton-per-day concentrator, new employee housing, and several ancillary facilities were constructed. Exploratory drilling to expand known mineralization was completed and further development and economic analysis were pursued to determine if this additional reserve can be mined and processed profitably. In 1978, the first year of expanded production at Bagdad, 68,648 tons of copper were produced, a total exceeding 95% of capacity.

The Bruce underground mine and mill were shut down on July 4, 1977, before the ore reserve was exhausted, because of operating losses due to the weak copper market. Mining of the Bruce orebody, a relatively high-grade massive sulfide deposit, began in 1968; during the ten-year period of production the average (weighted) sulfide grade was 3.65% Cu and 12.7% Zn. In the short life of the mine, it had an average ore production of about 95,000 tons per year (excluding the two years of startup and shut-down) and produced over 53 million pounds of copper and approximately 166 million pounds of zinc.

The Johnson mine operated at normal levels in 1977 and 1978. Operations consist of heap-leaching oxide ore and producing high-quality cathode copper in a solvent extraction-electrowinning facility.

The Cyprus Copper Process, a hydrometallurgical technique to reduce copper directly from copper sulfides, was successfully demonstrated in 1977. In August, high-purity copper wirebars were produced from sulfide concentrate at the pilot plant, located at the Cyprus Pima Mining Company's Pima mine, shipped to New York, and drawn into wire which met all industry specifications. An economic valuation of the process was completed in October and the study indicated that substantial savings are possible in both capital and operating costs compared with conventional pyrometallurgical smelting and refining and with other known hydrometallurgical processes.

Construction of a new Cyprus Copper Process demonstration plant (known locally as the CYMET plant) at the Pima mine was completed in November 1978. The primary objective of this new facility is to test and determine the size of equipment to be installed in a full-scale plant. The company continued studying the possibility of constructing a major Cyprus Copper Process plant capable of producing 75,000 tons-per-year of high-quality copper.

Cyprus Pima Mining Company

Because of the weak copper market, operations at the Pima mine were suspended indefinitely in September 1977. Although the mine was shut down through 1978, plans were announced late in the year that production would resume in mid-1979 at about 30% of capacity.

Duval Corporation

Operations at the Esperanza, Mineral Park, and Sierrita mines were normal in 1977 until their closure for six weeks in the late summer brought about by poor economic conditions. The Esperanza mine remained closed for the rest of the year but leaching of waste dumps and production of copper precipitates continued.

Although these production curtailments reduced total output in 1977, the company maintained its position as the leading producer of molybdenum in Arizona. The three Company properties, combined, accounted for 69% of the molybdenum produced in the state; the Sierrita mine alone contributed 50%.

In 1978 mining operations remained suspended at Esperanza while production of copper precipitates continued. Mineral Park and Sierrita increased production of copper and the company maintained first place in the production of molybdenum. The Sierrita mine produced 16,338,357 pounds of molybdenum, 52% of Arizona's production.

The CLEAR plant and the ferro-molybdenum production facility continued operations during the 1977-78 period. Operating at about 85% of design capacity in 1977, the CLEAR plant treated approximately one-quarter of Duval's copper concentrate production. The plant represents the first commercial application of a hydrometallurgical process instead of traditional pyrometallurgical smelting to produce copper metal. Commercial operation of the plant began during the first quarter of 1976. In 1978 the plant operated at about 78% of capacity.

Eisenhower Mining Company

The Anamax Mining Company and ASARCO Inc. are partners in the Eisenhower Mining Company formed to develop the Palo Verde deposit, lying between ASARCO's Mission and South San Xavier open-pit mines. Stripping of overburden from the deposit began in the third quarter of 1976 and ore production was planned to begin in January 1979.

Stripping by ASARCO, the mine operator, continued in 1977 except for an interruption beginning in July with the miners' strike and the shut-down caused by poor economic conditions. Anamax began construction of a primary crushing facility at Palo Verde and a 6¼-mile enclosed, single-flight conveyor from the crusher to the Twin Buttes mill. The unusual low-tension conveyor is reputed to be the second longest of its type operating in the world.

In 1978 Anamax completed installation of its new crusher and the conveyor. By the end of the year both partners were prepared to begin receiving and concentrating the sulfide ore. The planned production is 27,000 tons per year of copper contained in concentrates.

Freeport Minerals Company

Freeport Copper Company, a wholly owned subsidiary, has a 50% interest in a joint venture with ASARCO Inc. for the acquisition, exploration and possible development of potential copper-bearing properties near Casa Grande. Exploratory work and land acquisition continued on a limited scale during 1977 and 1978, but substantial further exploration and other work will be required before a determination can be made of the possibilities for commercial development.

Hecla Mining Company

Operations at the Lakeshore mine continued to improve in 1977. Oxide ore production increased 7% over the 1976 rate and sulfide ore production increased 26%. The rate of production of sulfide ore was lower (66% of the design rate) than desired, however, because of control problems in the block caving operation.

The production rate of cathode copper from sulfide ore and purchased concentrate was up 47% over that of 1976 and the production rate of copper in precipitate, from both oxide and sulfide ore, was up 54%. Total operating costs per pound of metal produced, exclusive of costs to purchase concentrates, were reduced 30%.

In spite of these improvements in operating performance, the deteriorating copper market caused such financial losses that operations had to be suspended August 29, 1977. The mine and plant facilities remained closed in 1978.

After extensive efforts failed to interest other companies as co-participants in the Lakeshore project, Hecla decided in June 1978 to dispose of its interest in the property. Hecla's partner, El Paso Natural Gas Company, announced on August 4 its intention also to dispose of its Lakeshore interest. On October 31, 1978, the two partners jointly terminated their mine leases with the Papago Tribe, and the Papagos immediately began a search for new operators.

Inspiration Consolidated Copper Company

A strike from July 1 to August 26, 1977, shut down all of Inspiration's operations in Arizona. Following the strike, operations resumed at the smelter, refinery, and sulfuric acid and rod fabricating plants. The mines and other treatment plants remained shut down for the balance of the year,

although recovery of copper by leaching at the Ox Hide property resumed in October. Production for the year from the Inspiration Area mines was approximately 35% of annual capacity and 50% from the Christmas mine.

During the strike extensive repairs were made to the smelter and acid plant. Copper production in the smelter's ten months of operation in 1977 was down only nine percent from the preceding year. The rod plant produced more continuous cast copper rod in the strike-shortened year than in the previous strike-free year.

In 1978 mining remained suspended at the Christmas and Ox Hide properties, although heap leaching operations were continued at the Ox Hide. Early in the year the Inspiration Area mines, concentrator and leaching plant operated on a five-day-per-week schedule. In April this schedule was increased to seven days per week. A new 17-cu. yard shovel and an overpass system that shortened the waste-haul distance increased the rate of waste removal and lowered the unit cost at the Inspiration Area properties. In June, the molybdenum recovery section of the concentrator was reactivated.

Construction of a new solvent extraction-electrowinning plant at the Inspiration Area property began in 1978. Additional drilling was carried out with a view to increasing the ore reserves.

During 1978 the smelter, refinery and acid plant operated seven days a week except for a four-week period in July and August when all operations were shut down for scheduled maintenance and repairs. The smelter and acid plant operated at about 93% of annual capacity. The rod plant operated five days per week on a two-shift basis.

In June 1975 the Hudson Bay Mining and Smelting Company, Ltd., of Canada, and the Minerals and Resources Corporation, Ltd., of Bermuda, purchased 850,000 shares of common stock in Inspiration. By July 31, 1978, the two companies had increased their holdings to 73% of Inspiration's common stock.

In December a decision was made to move the corporate offices from Morristown, New Jersey, to Phoenix, Arizona.

Kennecott Copper Corporation

During 1977 Kennecott's operations at the Ray property and the Hayden smelter were shut down for a total of five weeks because of a strike and the poor copper market. Late in the year the Ray mine received a new 15-cu. yd. shovel and six 250-ton-capacity haulage trucks needed to improve ore productivity and increase waste removal. In addition, the rail system was changed to operate fewer, but longer, trains. Ore tonnage per train increased from 3,900 to 5,500 tons. These improvements helped increase concentrator throughput from 25,000 tons per day to an average of 29,000.

In recognition of the decline in grade of ore mined at Ray, Kennecott decided in 1978 to install a regrind facility at the concentrator so that a higher grade concentrate could be produced as feed to the Hayden smelter, thereby increasing primary copper production. In addition, construction of a new solvent extraction-electrowinning plant was begun at Ray.

Newmont Mining Corporation

Mine production at San Manuel was continued at curtailed levels throughout 1977. Nevertheless, it remained the largest underground metal mining operation in the U.S. (This production facility combined with the Magma mine insured Newmont's position as the second largest producer of copper in the State during 1977 and 1978.) Total copper production, including the reprocessing of smelter slag begun in 1976, increased seven percent. A limited development program was continued during the year to gain access for underground drilling in the nearby Kalamazoo orebody.

Production at the Magma (Superior) mine was maintained at full capacity during 1977 and the concentrator continued to reprocess smelter slag. At mid-year the company began converting its reverberatory furnaces at the San Manuel smelter to burn coal as a primary fuel. The conversion is expected to be completed in 1979.

Unlike many other properties in Arizona, a new three-year labor contract was negotiated at the Magma and San Manuel operations without a strike.

In 1978 mine production at San Manuel was increased 15% over production in 1977. Daily production averaged about 88% of normal capacity. Mine development work, which had been balanced with current ore production, was accelerated in the fourth quarter to enable the mine to increase production to capacity levels late in 1979. Preparation for development of the nearby Kalamazoo orebody continued at a moderate rate as access drifts were advanced for this deeper deposit.

The Magma mine continued to operate at full capacity during 1978 except when it was affected by a three-week wildcat strike in April and May. Late in the year new coal-handling facilities were completed for the San Manuel smelter. Two of the reverberatory furnaces were modified to burn either coal, fuel oil, or natural gas. Conversion of the third furnace was begun during the year.

The electrolytic refinery at San Manuel operated at a rate matching that of the smelter in 1978. The fabrication plant produced continuous cast rod at capacity.

Occidental Petroleum Corporation

In 1977 the company satisfactorily completed the first phase of an in-situ solution mining test on the Van Dyke oxide copper deposit. Testing continued in 1978 with the second, more extensive phase. Oxymin (Occidental Minerals Corp.) reported that the tests satisfactorily demonstrated that copper can be recovered in solutions amenable to conventional hydrometallurgical treatment.

Oracle Ridge Mining Partners

In the summer of 1977 the joint venture between Continental Materials Corp. and Union Miniere, S.A., was formalized to bring the Oracle Ridge mine into production. The rate of underground development increased as major pieces of mining equipment were delivered throughout the second half of 1977 and placed in service. Final mill engineering and design work commenced in the last half of the year.

Other projects undertaken during 1977 included locating alternate sources of water, completing the first ventilation shaft at the 6,400 foot level, constructing a new access road and staffing the project with key personnel in mining, mill operations and administration. Construction was started on a new warehouse and office building in November 1977.

Over 11,000 feet of underground development was completed during 1978. By the end of the year, approximately 34% of the estimated amount of primary underground openings had been completed. Other projects finished in 1978 include construction of 16 miles of road, erection of the office, warehouse, and principal maintenance facilities, design of the mill and receipt of construction bids, conclusion of negotiations for electric power, and acquisition of some mine and mill equipment.

Late in the year the partners decided to curtail further development at the mine until an evaluation of several problems could be made. Specific concerns were ground reinforcement and cost, mineral continuity, and costs of rock removal. The partners began a comprehensive study of all geologic data to more precisely define the ore zones and reassess the underground mining conditions.

Phelps Dodge Corporation

Phelps Dodge operations continue to lead the State in the production of primary copper. In 1977 the company produced 382,979,182 pounds of recoverable copper, approximately 21% of the State's total production. In 1978 the company increased output to 471,956, 101 pounds representing about 24% of the total State production.

During 1977 work schedules at the mines and concentrators continued on a reduced basis. In addition, a strike closed the mines and smelters from July 1 to August 12, and the New Cornelia mine was shut down after the strike until October 2. Work schedules were increased in 1978.

Preliminary development work at the Dos Pobres deposit near Safford continued at reduced rates in 1977 and 1978. A pilot plant was constructed in 1978 at Bisbee to test the feasibility of extracting uranium oxide from the leach solutions used in the copper recovery operation. Research at Morenci was accelerated in 1978 on a hydrometallurgical process for the recovery of copper from concentrates as a possible alternative to smelting.

Ranchers Exploration and Development Company

During early 1977 the Bluebird mine operated at peak efficiency. Because of the deteriorating copper market, however, mining of ore was suspended October 14. Stripping of overburden continued through the year, as did production of cathode copper from ore previously placed in leaching heaps.

This curtailed production schedule continued in 1978. During mid-year 2,700,000 tons of ore adjoining the Bluebird open pit were acquired from Inspiration Consolidated Copper Company and mining of this material began in May.

Standard Metals Corporation

Standard Metals owns a 300 ton-per-day mill and the Antler mine at Yucca, Arizona. The company produced, at a loss, copper-zinc ore from the underground mine during 1970. Since it was closed in January 1971, the property has been on a standby basis.

Substantial exploration and development work in 1975 materially increased the ore reserve at the Antler. In 1978 the company announced that several major mining concerns had expressed an interest in providing it with enough financing to build a larger mill and to reopen the mine.

TABLE I

COPPER AND MOLYBDENUM PRODUCTION OF LARGE ARIZONA COPPER MINES

<u>Company</u> <u>Mine</u>	1977			1978		
	<u>Tons</u> <u>Copper Ore</u> <u>Mined</u>	<u>Pounds</u> <u>Recoverable</u> <u>Copper</u>	<u>Pounds</u> <u>Recoverable</u> <u>Molybdenum</u>	<u>Tons</u> <u>Copper Ore</u> <u>Mined</u>	<u>Pounds</u> <u>Recoverable</u> <u>Copper</u>	<u>Pounds</u> <u>Recoverable</u> <u>Molybdenum</u>
<u>ANAMAX</u>						
Twin Buttes	8,388,000	153,772,000	3,724,000	6,838,000	134,293,000	3,130,000
Cathode Cu		68,772,000			71,614,000	
Total	<u>8,388,000</u>	<u>222,544,000</u>	<u>3,724,000</u>	<u>6,838,000</u>	<u>205,907,000</u>	<u>3,130,000</u>
<u>ASARCO</u>						
Silver Bell 1/ Precipitate Cu	2,542,700	25,909,836		3,571,500	36,264,443	133,776
Mission	4,623,700	46,595,884	277,106	7,777,500	79,485,782	375,239
San Xavier 2/ Precipitate Cu	767,700	8,286,918		832,300	9,716,031	
Sacaton	597,400	12,860,408		874,300	15,182,947	
Total	<u>3,407,503</u>	<u>39,743,762</u>		<u>4,152,938</u>	<u>46,084,526</u>	
	<u>11,939,003</u>	<u>138,409,122</u>	<u>277,106</u>	<u>17,208,538</u>	<u>193,000,630</u>	<u>509,015</u>
<u>CITIES SERVICE -</u> <u>MIAMI OPERATIONS</u>						
Miami-Copper Cities Operations 3/ Precipitate Cu		3,345,797			3,806,000	
Miami Cathode Cu 4/		11,732,336			11,703,000	
Pinto Valley Opns.	13,500,541	121,635,044	337,406	15,808,000	145,596,000	450,000
Total	<u>13,500,541</u>	<u>136,713,177</u>	<u>337,406</u>	<u>15,808,000</u>	<u>161,105,000</u>	<u>450,000</u>

1/ Molybdenum production resumed in September 1978.

2/ Sulfide ore production began mid-1977. The ore is treated at the Mission concentrator.

3/ Copper Cities open-pit mine shutdown May 9, 1975, however, leaching operations continued through 1978.

4/ Cities Service's new solvent extraction-electrowinning plant came on stream in May 1976.

TABLE I (Cont.)

COPPER AND MOLYBDENUM PRODUCTION OF LARGE ARIZONA COPPER MINES

Company Mine	1977			1978		
	Tons Copper Ore Mined	Pounds Recoverable Copper	Pounds Recoverable Molybdenum	Tons Copper Ore Mined	Pounds Recoverable Copper	Pounds Recoverable Molybdenum
CYPRUS MINES CORP.						
Bagdad	3,906,008	33,089,976	592,227	13,536,027	123,199,966	2,577,425
Cathode Cu		15,010,833			14,096,686	
Bruce ^{5/}	40,710	3,007,532				
Cathode Cu	1,563,000	10,327,424		1,202,500	10,205,142	
Total	<u>5,309,718</u>	<u>61,435,765</u>	<u>592,227</u>	<u>14,738,527</u>	<u>147,501,794</u>	<u>2,577,425</u>
CYPRUS PIMA MINING CO.						
Pima Mine ^{6/}	14,135,110	110,658,072	1,158,326			
Total	<u>14,135,110</u>	<u>110,658,072</u>	<u>1,158,326</u>			
DUVAL						
Esperanza ^{7/}	4,117,824	20,371,009	2,311,141		7,468,902	
Precipitate Cu		8,636,194			25,539,227	4,512,456
Mineral Park	5,960,235	25,022,050	3,867,064	6,427,450	4,812,582	
Precipitate Cu		5,259,709				
Sierrita	29,739,871	117,107,834	16,243,214	33,185,272	199,154,769	16,338,357
Total	<u>39,817,930</u>	<u>236,356,796</u>	<u>22,421,419</u>	<u>39,612,722</u>	<u>236,975,480</u>	<u>20,850,813</u>

^{5/} Cyprus Bruce Copper and Zinc Company's copper production from copper-zinc ore. The Bruce mine ceased production July 4, 1977. The Company's zinc production for 1977 amounted to 9,236,294 pounds of zinc.

^{6/} The Pima mine suspended production September 27, 1977.

^{7/} The Esperanza mine suspended production August 8, 1977.

TABLE I (Cont.)

COPPER AND MOLYBDENUM PRODUCTION OF LARGE ARIZONA COPPER MINES

Company Mine	1977			1978		
	Tons Copper Ore Mined	Pounds Recoverable Copper	Pounds Recoverable Molybdenum	Tons Copper Ore Mined	Pounds Recoverable Copper	Pounds Recoverable Molybdenum
<u>HECLA MINING COMPANY</u>						
Lakeshore Mine <u>8/</u>						
Sulfide Ore	1,218,000	22,050,400				
Oxide Ore	1,271,000	25,031,000				
Total	<u>2,489,000</u>	<u>47,081,400</u>				
<u>INSPIRATION</u>						
Inspiration <u>9/</u>	2,496,821	29,121,761		5,630,211	59,622,640	61,507
Precipitate Cu		10,649,605			14,587,573	
Christmas Div <u>10/</u>	963,174	10,386,997				
Ox Hide Mine <u>11/</u>	1,541,970	4,639,398			4,147,394	
Total	<u>5,001,965</u>	<u>54,797,761</u>		<u>5,630,211</u>	<u>78,357,607</u>	<u>61,507</u>
<u>KENNECOTT</u>						
Ray	10,522,096	139,020,961	587,559	11,621,230	146,204,373	632,758
Precipitate Cu		24,333,532			25,013,140	
Total	<u>10,522,096</u>	<u>163,354,493</u>	<u>587,559</u>	<u>11,621,230</u>	<u>171,217,513</u>	<u>632,758</u>
<u>MAGMA</u>						
San Manuel	17,000,047	198,100,000	3,254,477	19,638,032	213,168,000	3,452,101
Repro.Smelter Slag	2,216,578	24,110,000		1,545,255	21,615,000	
Superior	1,034,563	84,135,000		980,837	77,108,000	
Repro.Smelter Slag	42,235	236,000		41,450	321,000	
Total	<u>20,293,423</u>	<u>306,642,000</u>	<u>3,254,477</u>	<u>22,205,574</u>	<u>312,212,000</u>	<u>3,452,101</u>

8/ The Lakeshore mine came on-stream January 1976 and then suspended production August 29, 1977.

9/ Includes ore treatment by vat leaching. Molybdenum production resumed in June 1978.

10/ The Christmas mine suspended production July 1, 1977.

11/ Mining of ore at the Ox Hide suspended July 1, 1977.

TABLE I (Cont.)

COPPER AND MOLYBDENUM PRODUCTION OF LARGE ARIZONA COPPER MINES

Company Mine	1977			1978		
	Tons Copper Ore Mined	Pounds Recoverable Copper	Pounds Recoverable Molybdenum	Tons Copper Ore Mined	Pounds Recoverable Copper	Pounds Recoverable Molybdenum
PHELPS DODGE						
Morenci Branch						
Morenci Mine	15,726,861	183,883,285		17,938,587	219,572,382	
Precipitate Cu		41,545,291			51,361,698	
Metcalf Mine	9,809,776	77,049,701		11,321,803	108,779,990	
New Cornelia Br.	6,823,153	71,975,272		8,486,019	84,309,533	
Copper Queen Br.						
Precipitate Cu 12/		8,525,633			7,932,498	
Total	<u>32,365,800</u>	<u>382,979,182</u>		<u>37,746,409</u>	<u>471,956,101</u>	
RANCHERS EXPLORATION & DEVELOPMENT CORPORATION						
Bluebird Mine 13/						
Cathode Cu	2,246,155	17,068,537		1,033,799	3,926,369	
Total	<u>2,246,155</u>	<u>17,068,537</u>		<u>1,033,799</u>	<u>3,926,369</u>	
TOTAL						
LARGE COMPANIES 14/	<u>166,209,741</u> 15/	<u>1,878,080,305</u> 16/	<u>32,352,520</u>	<u>172,443,010</u> 15/	<u>1,982,159,494</u> 16/	<u>31,633,619</u>

12/ This figure represents production from the Copper Queen underground mine, the Lavender Pit and the dumps. Leaching operations continue although the Copper Queen ceased production June 13, 1975, and the Lavender Pit ceased production December 14, 1974.

13/ Mining of ore at Bluebird was suspended October 14, 1977.

14/ For a comparison to all copper produced in Arizona with a classification of source material, reported by the U.S. Bureau of Mines, see Tables VIII and IX. Specific comparisons may differ due to times and methods of reporting.

15/ Includes 2,258,813 tons of smelter slag reprocessed by Magma in 1977 and 1,586,705 tons of smelter slag reprocessed in 1978 (see detail in this table).

16/ Includes 227,229,244 pounds of copper produced in 1977 and 240,598,980 pounds of copper produced in 1978 from chiefly leached material not classified generally as ore (see detail by company in this table). A more detailed, recent historical record of leach production only is given in Table II.

TABLE II

ARIZONA LEACH COPPER PRODUCTION 1/
(Thousand Pounds)

<u>Property</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>
Bagdad <u>2/</u>	14,781	7,281	14,681	13,391	14,267	13,508	14,321	14,606	15,011	14,097
Bisbee <u>3/</u>	7,002	7,407	8,345	10,000	8,532	6,402	8,377	7,893	8,526	7,932
Bluebird <u>4/</u>	9,921	11,520	12,458	14,680	15,005	15,344	15,122	17,876	17,069	3,926
Castle Dome	1,831	934	-	-	-	-	-	-	-	-
Copper Cities	3,799	4,491	4,376	4,577	4,570	3,295	3,562	3,370	3,346	3,806
Emerald Isle	4,180	3,713	3,822	3,629	2,180	-	-	-	-	-
Esperanza	3,619	4,428	4,454	2,094	2,268	1,817	3,960	6,412	8,636	7,469
Inspiration	45,108	48,097	45,588	56,487	50,401	47,765	52,470	45,545	20,883	35,945
Johnson	-	-	-	-	-	-	6,143	10,060	10,327	10,205
Lakeshore	-	-	-	-	-	-	-	28,407	25,031	-
Miami	13,756	14,965	12,806	12,170	11,988	11,969	13,076	13,509	11,732	11,703
Mineral Hill	2,887	-	-	-	-	-	-	-	-	-
Mineral Park	6,221	7,710	7,315	8,936	6,431	6,801	6,915	6,817	5,260	4,813
Morenci	22,754	16,950	14,188	24,493	25,668	22,704	23,778	53,136	41,545	51,362
Old Reliable	-	-	-	-	5,992	2,175	467	-	-	-
Ox Hide	7,243	13,298	7,962	9,673	8,950	9,679	10,107	7,915	4,639	4,147
Peacock	-	NA								
Ray <u>5/</u>	29,968	43,971	31,622	31,472	28,369	25,478	24,338	24,374	24,334	25,013
Red Hills	-	-	46	-	-	-	-	-	-	-
San Xavier	-	-	-	-	4,955	11,762	19,384	22,772	12,860	15,183

TABLE II (Cont.)

ARIZONA LEACH COPPER PRODUCTION ^{1/}
(Thousand Pounds)

Property	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Silver Bell ^{6/}	5,226	5,614	6,297	7,897	8,092	7,860	8,497	8,627	5,012	6,267
Twin Buttes	-	-	-	-	-	-	13,462	57,925	68,772	71,614
United Verde	248	232	165	140	214	44	32	-	-	-
Zonia	3,576	4,456	4,769	4,778	2,991	2,717	619	-	-	-
TOTAL	182,120	195,067	178,894	204,417	200,873	189,320	224,630	329,244	282,983	273,482
PERCENT OF PRIMARY COPPER PRODUCED ^{7/}	11.4	10.6	10.9	11.2	10.8	11.0	13.8	16.1	15.3	13.9

Source: Arizona Department of Mineral Resources.

- ^{1/} Copper recovered from precipitate and/or by solvent extraction from material dump, heap, vat or in situ leached.
- ^{2/} Precipitation replaced by solvent extraction in 1971.
- ^{3/} Lavender Pit and Copper Queen.
- ^{4/} Precipitation replaced by solvent extraction in 1969.
- ^{5/} Includes only copper contained in precipitates from dump leaching. Does not include copper produced by electrowinning.
- ^{6/} San Xavier discontinued production of Siliceous Flux and commenced production of copper precipitate as of 5/1/73.
- ^{7/} Leach copper compared to total copper produced from all primary sources as reported in "Minerals Yearbook - Area Reports: Domestic," U.S. Bureau of Mines.

NA Not Available

TABLE III

AVERAGE CU CONTENT OF ORE PRODUCED AT ARIZONA COPPER MINES
(Percent Total Copper)

<u>MINE OPERATION</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>
ANAMAX MINING COMPANY											
Twin Buttes											
Sulfide	-	1.01	1.24	0.99	0.98	0.82	0.63	0.60	1.12	1.11	1.26
Oxide	-	-	-	-	-	-	-	1.27	1.31	1.30	1.26
ARIZONA RANCH & METALS CO.											
Mineral Hill											
Oxide	-	-	-	-	-	-	-	-	-	-	-
ASARCO INCORPORATED											
Mission											
Sulfide	.70	.67	.67	.67	.61	.60	.61	.60	.62	.58	.59
Sacaton											
Sulfide	-	-	-	-	-	-	.63	.74	.71	.70	.67
San Xavier											
Sulfide	-	-	-	-	-	-	-	-	-	-	-
Oxide	-	-	-	-	-	-	-	-	-	-	-
Silver Bell											
Sulfide	.86	.70	.68	.65	.60	.64	.65	.72	.72	.65	.65
Oxide	-	-	-	-	-	-	-	-	-	-	-
Cu-bearing Silica Flux Mined 1968-72						.61	.77	1.05	1.12		
BIG HOLE MINING COMPANY											
United Verde											
Sulfide	5.4	6.4	6.3	5.2	4.9	5.1	4.8	5.7	-	-	-
Oxide	-	-	-	-	-	-	-	-	-	-	-

TABLE III (Cont.)

AVERAGE CU CONTENT OF ORE PRODUCED AT ARIZONA COPPER MINES
(Percent Total Copper)

<u>MINE OPERATION</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>
CITIES SERVICE COMPANY											
Castle Dome Oxide				-	-	-	-	-	-	-	-
Copper Cities Sulfide					(.50)			(.50)	-	-	-
Oxide											
Miami Oxide											
Pinto Valley Sulfide	-	-	-	-	-	-		(.45)	(.45)	.49	.52
CYPRUS MINES CORPORATION											
Bagdad Sulfide	.65	.66	.75	.81	.70	.70	.74	.70	.60	.59	.52
Oxide											
Bruce Sulfide	2.66	3.45	3.33	3.75	3.92	3.68	3.86	3.73	3.54	3.97	-
Johnson Oxide 1/	-	-	-	-	-	-	-	.42	.42	.46	.44
CYPRUS PIMA MINING COMPANY											
Pima Sulfide	.58	.54	.54	.54	.53	.51	.50	.48	.47	.48	-
EL PASO NATURAL GAS CO.											
Emerald Isle Oxide							-	-	-	-	-
HECLA MINING COMPANY											
Lakeshore Sulfide	-	-	-	-	-	-	-	-	.76	.91	-
Oxide 1/	-	-	-	-	-	-	-	-	1.03	.98	-

TABLE III (Cont.)

AVERAGE CU CONTENT OF ORE PRODUCED AT ARIZONA COPPER MINES
(Percent Total Copper)

<u>MINE OPERATION</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>
INSPIRATION CONSOLIDATED COPPER CO.											
Christmas (open pit)											
Sulfide		.77	.63	.65	.80	.74	.57	.57	.58	.74	-
Inspiration Area Mines											
Sulfide			.73	.69	.71	.67	.63	.65	.63	.70	.61
Oxide											
Ox Hide											
Oxide 1/			.37	.36	.30			.29	.27	.27	-
KENNECOTT COPPER											
Ray											
Sulfide			.97	.90	.89	.91	.83	.90	.86		
Oxide (silicate)			1.17	1.39	1.25	1.35	1.19	1.23	1.15		
McALESTER FUEL COMPANY											
Zonia											
Oxide	.70			(.53)	(.53)			(.53)	-	-	-
NEWMONT MINING CORPORATION											
Magma											
Sulfide	4.63		(4.4)	(4.4)	(4.5)			(4.5)	(4.5)	(4.5)	4.36
San Manuel											
Sulfide 2/	.70			(.7)	(.7)		.70	.64	(.7)	(.7)	.64
PENNZOIL CO. (Duval Corp.)											
Esperanza											
Sulfide	.50	.48	.45	.40	-	.34	.31	.26	.29	.29	-
Oxide											
Mineral Park											
Sulfide	.51	.52	.50	.50	.41	.38	.36	.30	.28	.28	.26
Oxide											
Sierrita											
Sulfide			.28	.27	.29	.28	.29	.33	.35	.34	.33

TABLE III (Cont.)

AVERAGE CU CONTENT OF ORE PROCURED AT ARIZONA COPPER MINES
(Percent Total Copper)

<u>MINE OPERATION</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>
PHELPS DODGE CORPORATION											
Copper Queen											
Sulfide	4.08	4.23	4.36	4.31	4.41	4.06	3.48	5.70	-	-	-
Oxide											
Lavender											
Sulfide	.67	.81	.77	.68	.64	.60	.47	-	-	-	-
Oxide											
Metcalf											
Sulfide	-	-	-	-	-	-	-	.84	.86	.70	.79
Oxide	-	-	-	-	-	-	-				
Morenci											
Sulfide	.84	.86	.85	.85	.83	.82	.82	.79	.80	.81	.80
Oxide											
New Cornelia											
Sulfide	.74	.73	.68	.67	.70	.61	.57	.57	.66	.64	.59
RANCHERS EXPLORATION & DEVELOPMENT CORP. 3/											
Bluebird											
Oxide				.46	.44			.48	.58	.79	.70
Old Reliable											
Oxide	-	-	-	-	.74	.74	.74	.74	-	-	-

TABLE III (Cont.)

AVERAGE CU CONTENT OF ORE PRODUCED AT ARIZONA COPPER MINES
(Percent Total Copper)

<u>MINE OPERATION</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>
STANDARD METALS CORPORATION Antler Sulfide	-	-	-	-	-	-	-	-	-	-	-
WEIGHTED AVERAGE <u>SULFIDE</u> GRADE <u>4/</u>	<u>.72</u>	<u>.73</u>	<u>.73</u>	<u>.64</u>	<u>.64</u>	<u>.60</u>	<u>.57</u>	<u>.56</u>	<u>.61</u>	<u>.57</u>	<u>.61</u>

Source: Company Annual Reports, Form 10-K's, and Prospectus; "International Directory of Mining and Mineral Processing Operations," E/MJ; Arizona Department of Mineral Resources.

() Percentage in parenthesis is approximate; not used in calculation of weighted average.

1/ Acid soluble copper.

2/ Sulfide copper.

3/ Fiscal year from July 1 to June 30.

4/ Weighted average grade of ore milled; based generally on an assay of total copper.

TABLE IV
CONTAINED CU RECOVERIES AT ARIZONA COPPER MINES 1/
(Percent of Total Copper)

MINE OPERATION		1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Twin Buttes	Sulfide	-	68	80	72	76	72	71	63	68	87	76
	Oxide	-	-	-	-	-	-	-	65	75	76	79
Mineral Hill	Oxide	-	-	-	-	-	-	-	-	-	-	-
Mission	Sulfide	90	91	86	88	89	88	88	88	89	87	87
Sacaton	Sulfide	-	-	-	-	-	-	78	82	82	82	83
San Xavier	Sulfide	-	-	-	-	-	-	-	-	-	-	-
	Oxide	-	-	-	-	-	49	63	67	77	-	-
Silver Bell	Sulfide	65	74	75	78	85	80	78	77	81	78	78
Copper Cities	Sulfide	-	-	-	-	-	-	-	-	-	-	-
Pinto Valley	Sulfide	-	-	-	-	-	-	-	-	-	92	89
Bagdad	Sulfide	81	76	73	77	88	82	77	81	86	73	83
Bruce	Sulfide	85	85	85	85	90	90	90	93	92	88	-
Johnson	Oxide <u>2/</u>	-	-	-	-	-	-	-	43	91	90	96
Pima	Sulfide	85	86	84	86	84	85	85	82	84	79	-
Emerald Isle	Oxide	-	-	-	-	-	-	-	-	-	-	-
Lakeshore	Sulfide	-	-	-	-	-	-	-	-	100	99	-
	Oxide <u>2/</u>	-	-	-	-	-	-	-	-	98	100	-
Christmas (OP)	Sulfide	-	72	75	68	76	66	70	73	77	74	-
Inspiration Area	Sulfide <u>3/</u>	-	-	39	47	47	45	48	46	45	54	55
	Oxide	-	-	-	-	-	-	-	-	-	-	-
Ox Hide	Oxide <u>2/</u>	-	-	47	42	67	-	-	76	67	56	-
	Sulfide	-	-	-	-	-	-	-	-	-	-	-
Ray	Oxide <u>4/</u>	-	-	-	-	-	-	-	-	-	-	-
Zonia	Oxide	-	-	-	-	-	-	-	-	-	-	-
Magma	Sulfide	95	-	-	-	-	-	-	-	-	-	90
San Manuel	Sulfide <u>5/</u>	93	-	-	-	-	-	90	87	-	-	85

TABLE IV (Cont.)
CONTAINED CU RECOVERIES AT ARIZONA COPPER MINES 1/
(Percent of Total Copper)

MINE OPERATION		1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Esperanza	Sulfide	81	78	83	87	-	87	89	90	91	85	-
Mineral Park	Sulfide	79	82	80	80	77	81	72	81	73	75	76
	Oxide											
Sierrita	Sulfide	-	-	84	91	84	90	89	90	88	88	91
Copper Queen	Sulfide	88	89	87	88	95	90	90	92	-	-	-
Lavender	Sulfide	67	65	70	64	69	67	52	-	-	-	-
Metcalf	Sulfide	-	-	-	-	-	-	-	63	54	56	61
	Oxide	-	-	-	-	-	-	-	-	-	-	-
Morenci	Sulfide	73	76	74	76	75	71	74	70	70	72	77
	Oxide											
New Cornelia	Sulfide	88	87	87	86	84	85	85	80	80	82	84
Bluebird	Oxide <u>6/</u>				45	35			34	36	38	85
Antler	Sulfide	-	-	-	-	-	-	-	-	-	-	-

Source: Company Annual Reports and Form 10-K's; Arizona Department of Mineral Resources.

- 1/ Recoveries are based on available reported production and average grade of material treated.
A number of oxide operations are not listed because of inadequate data.
- 2/ Percent recovery of acid soluble copper.
- 3/ Percent recovery in flotation-concentration treatment, after ore has been leached.
- 4/ Silicate treatment.
- 5/ Percent recovery of sulfide copper.
- 6/ Fiscal year from July 1 to June 30.

TABLE V

STRIPPING RATIOS AT ARIZONA OPEN-PIE COPPER MINES ^{1/}
(Waste: Ore)

Mine	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Twin Buttes	-	20.1:1 ^{2/}	7.3:1	10.2:1	5.3:1	7.6:1	10.8:1	71.6:1 ^{3/}	5.5:1	5.6:1	2:1
Mission	2.7:1	2.6:1	2.3:1	3.1:1	3.1:1	2.5:1	2.3:1	1.5:1	1.5:1	2.3:1	2.3:1
Sacaton	-	-	-	-	-	-	-	6.3:1	5.9:1	4.4:1	2.7:1
San Xavier	-	-	-	-	-	-	-	-	5.1:1	5:1	1.1:1
Silverbell	1.9:1	2.2:1	2.7:1	2.6:1	2.5:1	3.5:1	3.4:1	2:1	1.6:1	1.8:1	1.4:1
Copper Cities	1.7:1	1.8:1	3.1:1	2:1	1.1:1	1:1.3	1:3.1	-	-	-	-
Pinto Valley	-	-	-	-	-	-	-	1.8:1	1.7:1	1.7:1	1.6:1
Bagdad	3.7:1	4:1	4.1:1	4.4:1	5.2:1	5.2:1	4.5:1	1.2:1	9.8:1	7.8:1	1.7:1
Johnson	-	-	-	-	-	-	-	1:1.8	1.5:1	1.6:1	2.5:1
Pima	-	-	-	-	-	1.6:1	2.8:1	2:1	2:1	1.6:1	-
Christmas	5.1:1	4.4:1	5.5:1	4.1:1	4.9:1	5.8:1	5.1:1	3.4:1	3.1:1	4.4:1	-
Inspiration Area	1:1	1.3:1	1.5:1	1.7:1	1.8:1	1.9:1	2.2:1	3.1:1	1.9:1	2.4:1	2.8:1
Ox Hide	0	1:11.4	1:4.8	1:391.4	1:2.3	1:35.6	1:3.1	1:2.6	1:2.6	1:4.9	-
Ray	2.8:1	2.3:1	2.1:1	1.7:1	2.7:1	2.6:1	3:1	3.5:1	2.6:1	2.5:1	3.1:1
Esperanza	1.4:1	1.7:1	1.5:1	1.4:1	-	1.5:1	1.5:1	1:1.4	1.1:1	1.1:1	-
Mineral Park	1.8:1	1.8:1	1.4:1	1.4:1	1:1.2	1:1.5	1:1.1	1:1.5	2.1:1	1.6:1	1.5:1
Sierrita	-	70.7:1 ^{2/}	3.3:1	1.8:1	1.7:1	1.5:1	1.7:1	1.4:1	1.5:1	1.6:1	1.3:1
Lavender	4.5:1	4:1	2.7:1	1.5:1	1.2:1	1.1:1	1:1.2	-	-	-	-
Metcalf	-	-	-	-	-	-	-	2.8:1	1.8:1	1.8:1	1.5:1

TABLE V (Cont.)

STRIPPING RATIOS AT ARIZONA OPEN-PIT COPPER MINES ^{1/}
(Waste: Ore)

<u>Mine</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>
Morenci	1.8:1	1.8:1	1.8:1	2.2:1	1.9:1	2:1	1.8:1	1.3:1	1.5:1	1.5:1	1.4:1
New Cornelia	1.9:1	1.6:1	1.5:1	2:1	1.9:1	1.9:1	1.5:1	1.5:1	1.1:1	1.1:1	1.4:1
Bluebird ^{4/}	1:3.4		1:1.5	1:1	1:1.2		1:1	1.3:1	1.3:1	1.8:1	3.3:1
AVERAGE	2.2:1	2.3:1 ^{5/}	2.6:1	2.6:1	2.3:1	2.5:1	2.6:1	2:1 ^{6/}	2.7:1	2.6:1	2:1

Source: "Minerals Yearbook - Area Reports: Domestic", U.S. Bureau of Mines; Company Annual Reports; E&MJ International Directory of Mining and Mineral Processing Operations; Arizona Department of Mineral Resources.

^{1/} Leachable rock included with waste (except at solely leach operations).

^{2/} Includes preproduction stripping.

^{3/} Stripping continued as sulfide concentrator was shut down from March 1975 to January 1976.

^{4/} Fiscal year from July 1 to June 30.

^{5/} Excludes ratios at Twin Buttes and Sierrita.

^{6/} Excludes ratio at Twin Buttes.

TABLE VI

ARIZONA PRODUCTION AND VALUE OF COPPER, MOLYBDENUM, GOLD, AND SILVER

RECOVERED FROM COPPER ORE

<u>Year</u>	<u>Copper Ore 1/ Tons</u>	<u>Gold 2/ Troy Ounces Value 5/</u>	<u>Silver 2/ Troy Ounces Value 6/</u>	<u>Molybdenum 3/ 1,000 lbs. Value (in \$1,000)</u>	<u>Copper 4/ Pounds Value</u>	<u>Lbs/Ore-Ton Ave. ¢/lb. 7/</u>	<u>Value of Copper Gold, Silver & Molybdenum</u>
1968	101,293,963	89,419 \$3,510,600	4,697,394 \$10,074,000	12,127 \$19,207	1,146,313,600 \$ 479,698,900	11.32 41.847	\$ 512,489,500
1969	127,848,828	108,718 \$4,586,800	5,899,843 \$10,564,700	12,699 \$20,947	1,477,520,000 \$ 702,324,400	11.56 47.534	\$ 738,422,900
1970	150,240,842	107,292 \$3,904,400	7,130,261 \$12,626,700	15,672 \$26,700	1,694,294,000 \$ 977,608,000	11.28 57.700	\$1,020,839,100
1971	149,293,547	93,617 \$3,820,510	6,106,204 \$ 9,437,749	22,684 \$39,872	1,529,780,500 \$ 786,812,004	9.76 51.433	\$ 839,942,263
1972	165,914,825	102,526 \$5,987,518	6,614,957 \$11,143,226	27,216 \$46,791	1,695,858,000 \$ 858,392,446	10.22 50.617	\$ 922,314,190
1973	181,311,945	102,376 \$10,013,397	7,164,988 \$18,325,173	37,657 \$59,372	1,735,012,000 \$1,021,314,814	9.57 58.865	\$1,109,025,384
1974	178,913,296	90,206 \$14,488,424	6,308,721 \$29,701,332	28,346 \$57,067	1,609,808,000 \$1,233,901,735	9.00 76.649	\$1,335,158,491

TABLE VI (Cont.)

ARIZONA PRODUCTION AND VALUE OF COPPER, MOLYBDENUM, GOLD AND SILVER
RECOVERED FROM COPPER ORE

Year	Copper Ore <u>1/</u> Tons	Gold <u>2/</u> Troy Ounces Value <u>5/</u>	Silver <u>2/</u> Troy Ounces Value <u>6/</u>	Molybdenum <u>3/</u> 1,000 lbs. Value (in \$1,000)	Copper <u>4/</u> Pounds Value	Lbs./Ore-Ton Ave.¢/lb. <u>7/</u>	Value of Copper Gold, Silver & Molybdenum
1975	168,750,152	82,759 \$13,364,751	6,190,805 \$27,354,196	25,030 \$61,411	1,502,978,000 \$ 954,917,072	8.91 63.535	\$1,057,047,019
1976	194,136,559	97,961 \$12,276,473	7,308,395 \$31,816,805	31,073 \$89,148	1,912,430,000 \$1,316,210,823	9.85 68.824	\$1,449,452,101
1977	168,641,401	87,874 \$13,032,593	6,696,415 \$30,957,660	34,574 \$120,497	1,705,240,000 \$1,122,184,339	10.11 65.808	\$1,166,295,089
1978	178,204,491	92,508 \$17,905,108	6,611,781 \$35,709,502	33,029 \$150,142	1,817,670,000 \$1,190,755,617	10.20 65.510	\$1,244,520,369

Source: "Minerals Yearbook - Area Reports: Domestic," U.S. Bureau of Mines.

1/ Includes some copper-zinc and/or lead-zinc ore in 1972 and thereafter.

2/ Excludes gold and silver recovered from vat or heap leaching of copper ores and from copper tailings or copper cleanup in 1969 and thereafter.

3/ Molybdenum content of recovered concentrate.

4/ Excludes precipitate copper from dump and in-place leaching.

5/ At average domestic, free-market gold price in 1968 and thereafter: year 1968, \$39.26 per oz.; 1969, \$42.19; 1970, \$36.39; 1971, \$40.81; 1972, \$58.40; 1973, \$97.81; 1974, \$159.73; 1975, \$161.49; 1976, \$125.32; 1977, \$148.31; 1978, \$193.55.

6/ At E/MJ average N.Y. market price for .999 fine silver.

7/ At E/MJ average price, domestic f.o.b. refinery.

TABLE VII

MINERAL PRODUCTION IN ARIZONA ^{1/}

Mineral		1977		1978	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays ^{2/}	thousand short tons	33	\$ 444	38	\$ 509
Coal (bituminous)	do	11,645	W	3/	3/
Copper (recoverable content of ores, etc.)	short tons	923,778	1,234,168	982,606	1,306,866
Gem stones		NA	4,500	NA	5,000
Gold (recoverable content of ores, etc.)	troy ounces	90,167	13,373	90,220	17,384
Gypsum	thousand short tons	187	775	202	1,226
Lead (recoverable content of ores, etc.)	short tons	318	195	460	313
Lime	thousand short tons	474	15,528	589	21,639
Molybdenum (content of concentrate)	thousand short tons	34,574	120,497	33,029	150,142
Natural gas	million cubic feet	240	80	3/	3/
Petroleum (crude)	thousand 42-gallon barrels	427	2,243	3/	3/
Pumice	thousand short tons	621	1,226	635	1,602
Sand and gravel	do	22,313	49,946	23,000	54,000
Silver (recoverable content of ores, etc.)	thousand troy ounces	6,828	31,546	6,471	34,943
Stone:					
Crushed	thousand short tons	5,359	16,367	5,250	15,600
Dimension	do	8	128	-	-

TABLE VII (Cont.)

MINERAL PRODUCTION IN ARIZONA ^{1/}

Mineral	Quantity	1977		1978	
		Value (thousands)	Quantity	Value (thousands)	
Zinc (recoverable content of ores, etc.)	short tons	4,308	\$ 3,013	-	\$ -
Value of items that cannot be disclosed: Asbestos, Cement, Clays (ball and common), Feldspar, Flourspar, Helium (high purity), Iron ore, Mica (crude) ^{4/} , Perlite, Pyrite, Salt, Sand and gravel (industrial), Tungsten, and values indicated by symbol W					
Total		XX	63,082	XX	70,948
		XX	\$1,557,111	XX	\$1,680,172 ^{4/}

Source: "The Mineral Industry of Arizona," U.S. Bureau of Mines, January 1978.

W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable. p/ Preliminary. NA Not available.

- 1/ Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
- 2/ Excludes ball clay and common clay.
- 3/ These data are now collected by Department of Energy; not available at the time this table was prepared.
- 4/ Incomplete total, excludes bituminous coal, natural gas and petroleum.

TABLE VIII

ARIZONA MINE PRODUCTION (RECOVERABLE) OF GOLD, SILVER, COPPER, LEAD AND ZINC IN 1977 BY CLASS OF ORE OR OTHER SOURCE MATERIAL

Source	No. of mines <u>1/</u>	Materials sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Lode ore:							
Silver	<u>4</u>	18,337	2,036	117,467	12	2	-
Copper	25	168,600,691	87,720	6,680,543	851,192	258	15
Copper-zinc	<u>1</u>	40,710	154	15,872	1,429	-	4,364
Total <u>2/</u>	26	168,641,401	87,874	6,696,415	852,620	258	4,380
Other lode material:							
Gold-silver tailings, copper cleanup, & copper tailings <u>3/</u>	5	2,256,319 <u>4/</u>	257	14,263	25,217	58	-
Copper precipitates	11	58,003	-	-	45,929	-	-
Total <u>2/</u>	16	2,314,322	257	14,263	71,146	58	-
Grand Total <u>2/</u>	35	170,974,060	90,167	6,828,145	923,778	318	4,380

Source: "Minerals Yearbook-Area Reports: Domestic," U.S. Bureau of Mines

1/ Detail will not add to total because some mines produce more than one class of material.

2/ Data may not add to total shown because of independent rounding.

3/ Combined to avoid disclosing individual company confidential data.

4/ Excludes newly generated tailings.

TABLE IX

ARIZONA MINE PRODUCTION (RECOVERABLE) OF GOLD, SILVER, COPPER, LEAD AND ZINC IN 1978 BY CLASS OF ORE OR OTHER SOURCE MATERIAL

Source	No. of mines <u>1/</u>	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Lode ore:							
Silver	2	3,765	33	10,169	3	1	(<u>2/</u>)
Copper-lead	27	178,200,726	92,508	6,611,781	908,835	356	69
Total <u>3/</u>	29	178,204,491	92,541	6,621,950	908,838	357	69
Other lode material:							
Gold-silver tailings & copper tailings <u>4/</u>	1	11,591,657 <u>5/</u>	448	15,888	10,886	102	-
Copper precipitates	12	98,853	-	-	62,882	-	-
Total <u>3/</u>	13	1,690,510	448	15,888	73,768	102	-
Grand Total <u>3/</u>	42	179,895,001	92,989	6,637,838	982,606	459	69

Source: "Minerals Yearbook - Area Reports: Domestic," U.S. Bureau of Mines.

1/ Detail will not add to total because some mines produce more than one class of material.

2/ Less than $\frac{1}{2}$ unit.

3/ Data may not add to total shown because of independent rounding.

4/ Combined to avoid disclosing individual company confidential data.

5/ Excludes newly generated tailings.

TABLE X

MAJOR DESIGNED COPPER CAPACITY IN ARIZONA ^{1/}
 (*)(Short Tons of Recoverable Copper/Year)

<u>OPERATOR</u>	<u>MINE</u>	<u>CAPACITY</u>
Phelps Dodge	Morenci	150,000
Newmont	San Manuel	140,000
Anamax	Twin Buttes	126,000
Kennecott	Ray	95,000
Pennzoil (Duval)	Sierrita	90,000
Cyprus	Pima	80,000
Cyprus	Bagdad	75,000
Papago Tribe	Lakeshore	65,000
Cities Service	Pinto Valley	62,500
Phelps Dodge	Metcalf	60,000
Hudson Bay (Inspiration)	Inspiration Area	55,000
Phelps Dodge	New Cornelia	50,000
ASARCO	Mission	45,000
Newmont	Magma (Superior)	40,000
ASARCO	Silver Bell	25,000
ASARCO	Sacaton	21,000
Pennzoil (Duval)	Mineral Park	20,000
Pennzoil (Duval)	Esperanza	18,000
ASARCO	San Xavier	12,000
Ranchers	Bluebird	8,000
Cities Service	Miami	6,000
Hudson Bay (Inspiration)	Christmas	6,000
Cyprus	Johnson	5,000
Hudson Bay (Inspiration)	Ox Hide	5,000
Phelps Dodge	Copper Queen/Lavender	4,000
Ranchers	Old Reliable	2,000
Cities Service	Copper Cities	1,500
TOTAL		<u>1,267,000</u>

Source: Arizona Department of Mineral Resources file data; Company Annual Reports and Form 10-K; Professional Publications.

^{1/} Figures generally represent a current estimate of the potential productive capacity of primary recoverable copper in concentrates, precipitates, and cathodes. Figures do not represent smelter or refinery capacity. The estimates are based on recent production figures and on capacities of concentrator and leachplant facilities. Other factors affecting actual production include, for example, grade of ore and recovery. Some capacities have been published by the reporting company.

TABLE XI

MINE PRODUCTION OF RECOVERABLE COPPER IN THE UNITED STATES
(Short Tons)

<u>State</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>Rank In</u> <u>1978</u>
Arizona	1,024,421	923,778	982,606	1
California	375	221	W	
Colorado	2,431	1,896	1,303	10
Idaho	3,362	4,052	4,286	9
Maine	1,766	1,337	-	
Michigan	43,707	42,375	38,380	5
Missouri	11,050	11,737	11,925	8
Montana	91,111	86,203	74,214	4
Nevada	58,160	67,061	22,546	6
New Mexico	172,360	164,698	140,906	3
Oregon	-	6	W	
Pennsylvania	240	W	-	
Tennessee	11,131	6,187	12,444	7
Utah	185,458	194,130	205,394	2
Washington	14	W	W	
Other States ^{1/}	-	285	2,469	
TOTALS	1,605,586	1,503,966	1,496,483	

Source: "Minerals Yearbook - Metals, Minerals, and Fuels,"
U.S. Bureau of Mines.

W: Withheld to avoid disclosing individual company
proprietary data; included in "Other States."

^{1/} Includes: Pennsylvania and Washington, in 1977; Alaska,
California, Oregon and Washington in 1978.

TABLE XII

"COVERED EMPLOYMENT" AND WAGES IN ARIZONA COPPER MINING AND SMELTING

Year	Average No. Covered Employees <u>1/</u>	Total Wages	Average Annual Wage	Average Weekly Wage	Tons Copper Ore <u>2/</u>
1948	11,493	\$41,318,524	\$3,595	\$69.13	39,072,204
1949	11,001	40,612,224	3,692	71.00	37,365,611
1950	10,181	41,994,321	4,125	79.33	41,757,273
1951	10,754	47,825,698	4,447	85.52	42,784,388
1952	11,365	54,950,235	4,835	93.14	44,472,522
1953	12,068	62,742,982	5,199	99.98	45,187,838
1954	12,502	65,518,853	5,241	100.79	43,072,894
1955	12,399	71,293,263	5,750	110.58	52,189,728
1956	14,008	83,568,996	5,966	114.73	60,468,580
1957	14,652	85,125,320	5,809	111.71	59,571,834
1958	14,100	74,726,972	5,300	101.93	56,255,809
1959	11,568	72,095,130	6,232	119.85	53,121,545
1960	13,764	90,312,848	6,562	126.19	66,032,439
1961	14,275	97,271,286	6,814	131.04	71,918,991
1962	14,408	101,920,108	7,074	136.04	78,868,147
1963	14,303	104,291,588	7,292	140.23	80,615,132
1964	14,720	113,792,031	7,730	148.65	86,132,039
1965	15,239	122,163,124	8,016	154.16	92,859,535
1966 <u>1/</u>	17,018	137,187,611	8,061	155.02	101,558,298
1967	13,426	108,427,206	8,076	155.31	74,289,203
1968	15,734	136,089,579	8,649	166.33	101,293,963
1969	19,459	173,183,018	8,900	171.15	127,848,828

TABLE XII (Cont.)

"COVERED EMPLOYMENT" AND WAGES IN ARIZONA COPPER MINING AND SMELTING

Year	Average No. - Covered Employees <u>1/</u>	Total Wages	Average Annual Wage	Average Weekly Wage	Tons Copper Ore <u>2/</u>
1970	21,479	201,665,064	9,389	180.56	150,241,000
1971	21,231	211,978,597	9,984	192.00	149,294,000
1972	23,233	254,717,341	10,964	210.85	165,914,825 <u>2/</u>
1973	25,494	291,294,328	11,426	218.89	181,311,945
1974	27,894	340,832,096	12,219	234.98	178,913,296
1975	25,950	363,349,178	14,002	269.27	168,750,152
1976	25,631	405,289,034	15,812	304.08	194,136,559
1977	23,373	398,539,789	16,835	323.75	168,641,401
1978	21,092	\$397,790,419	\$18,860	\$362.69	178,204,491

Source: This report, Table XIII; "Minerals Yearbook-Area Reports: Domestic," U.S. Bureau of Mines.

1/ "Covered Employment" by law includes all employees of employers of three or more persons. Since the "Average Number of Covered Employees" in this table generally includes practically all workers in copper mining and processing (see Table XIII), the number of employees is greater than that number tabulated under "All Employees" in Table XIV. Prior to 1966 only a portion of the workers in smelting, refining, and rod fabrication were included in this table; the rest of the end-processing workers were separated and classified under "Manufacturing" in Table XIII.

2/ Mine production in short tons from "Lode ore: Copper" reported by the U.S. Bureau of Mines. In 1972 and thereafter the tonnage may include copper-zinc and lead-zinc ore combined to avoid disclosing individual company confidential data.

TABLE XIII

ARIZONA INDUSTRIES COVERED BY SOCIAL SECURITY

YEAR 1977

<u>Industry</u>	<u>Average No. of Employees 1/</u>	<u>Total Wages</u>	<u>Average Annual Wage</u>	<u>Average Weekly Wage</u>
Copper Mining	19,762	\$337,755,887	\$17,091	\$328.67
Copper Smelting, Refining, & Rod Fabrication	3,611	60,783,902	16,833	323.71
Total Copper Mining & Processing	23,373	398,539,789	17,051	327.91
Other Mining, Quarry & Processing	2,272	45,325,005	19,949	383.63
All Mining, Quarry & Processing	25,645	443,864,794	17,308	332.85
Mfg. Except Copper Processing	111,086	1,445,252,833	13,010	250.19
Construction	52,567	742,947,361	14,133	271.79
Transp., Utilities, etc. 2/	38,608	573,468,153	14,854	285.65
Wholesale-Retail Trade	196,215	1,598,312,212	8,146	156.65
Services, Finance and Misc.	194,297	1,753,113,455	9,023	173.52
Agriculture & Related Services	4,154	34,426,036	8,287	159.37
State & Local Government	49,162	476,259,447	9,688	186.31
TOTAL AND AVERAGES	671,734	\$7,067,644,291	\$10,521	\$202.34

TABLE XIII (Cont.)

ARIZONA INDUSTRIES COVERED BY SOCIAL SECURITY

YEAR 1978

<u>Industry</u>	<u>Average No. of Employees^{1/}</u>	<u>Total Wages</u>	<u>Average Annual Wages</u>	<u>Average Weekly Wages</u>
Copper Mining	17,100	\$327,447,370	\$19,149	\$368.25
Copper Smelting, Refining & Rod Fabrication	3,992	70,343,049	17,621	338.87
Total Copper Mining & Processing	21,092	397,790,419	18,860	362.69
Other Mining, Quarry & Processing	2,222	44,764,250	20,146	387.42
All Mining, Quarry & Processing	23,314	442,554,669	18,982	365.05
Mfg., Except Copper Processing	122,918	1,709,486,502	13,908	267.45
Construction	71,180	1,078,595,460	15,153	291.40
Transp., Utilities, etc. ^{2/}	41,687	677,531,528	16,253	312.56
Wholesale-Retail Trade	218,479	1,923,107,138	8,802	169.27
Services, Finance and Misc.	218,049	2,124,479,341	9,743	187.37
Agriculture & Related Services ^{3/}	21,502	158,078,017	7,352	141.38
State & Local Government ^{3/}	153,584	1,627,811,967	10,599	203.82
TOTALS AND AVERAGES	870,713	\$9,741,644,622	\$11,188	\$215.16

Source: Research & Statistics Unit, Unemployment Insurance Bureau, Az. Dept. of Economic Security.

^{1/} Includes all covered employees.

^{2/} Transportation exclusive of railroads.

^{3/} Changes in the Unemployment Insurance Law effective 1/1/78, added agricultural, domestic and local government workers as well as school employees of both public and private primary & secondary schools.

TABLE XIV

EMPLOYMENT, EARNINGS AND HOURS IN COPPER MINING

IN THE UNITED STATES AND ARIZONA 1/

Period	All Employees		Production Workers											
	Average No. (Thousands)		Average No. (Thousands)		Average Weekly Earnings		Average Weekly Hours		Average Hourly Earnings		Ave. Earnings per Man per Year		Aggregate Man-hours (Thousands)	
	2/ Ariz.	3/ U.S.	4/ Ariz.	3/ U.S.	5/ Ariz.	U.S.	Ariz.	U.S.	6/ Ariz.	U.S.	7/ Ariz.	U.S.	8/ Ariz.	U.S.
1968	13.8	28.1	11.1	21.3	\$149.21	\$161.68	43.0	47.0	\$3.47	\$3.44	\$7,759	\$8,407	24,820	52,057
3 mos.	7.5	14.9	4.3	8.3	118.17	129.06	36.7	40.2	3.22	3.21				
9 mos.	15.8	32.5	13.0	25.6	160.11	165.28	45.1	47.8	3.55	3.46				
1969	17.0	33.7	13.9	26.9	166.50	169.00	44.4	46.3	3.75	3.65	8,658	8,788	32,092	64,764
1970	18.8	37.0	14.9	29.5	173.01	175.67	43.8	44.7	3.95	3.93	8,997	9,135	33,936	68,570
1971	18.9	34.7	14.9	26.8	178.50	178.46	42.4	42.9	4.21	4.16	9,282	9,280	32,852	59,785
1972	20.5	38.9	16.1	30.7	194.69	192.19	41.6	41.6	4.68	4.62	10,124	9,994	34,827	66,410
1973	21.5	42.3	17.6	33.7	206.75	206.42	41.6	42.3	4.97	4.88	10,751	10,734	38,072	74,127
1974	24.0	42.8	19.1	33.8	222.16	226.46	39.6	41.1	5.61	5.51	11,552	11,776	39,331	72,237
1975	22.5	37.1	17.9	28.4	247.43	247.14	38.6	39.2	6.41	6.33	12,866	12,903	35,929	57,891
1976	21.7	35.5	17.2	27.0	286.31	280.70	40.1	40.1	7.14	7.00	14,888	14,596	35,865	56,300
1977	19.3	35.1	15.3	26.9	302.99	288.73	39.4	38.6	7.69	7.48	15,755	15,014	31,347	53,994
1978	17.2	35.2	13.7	26.9	344.76	338.40	40.8	40.0	8.45	8.46	17,928	17,597	29,066	55,952

TABLE XIV (Cont.)

EMPLOYMENT, EARNINGS AND HOURS IN COPPER MINING

IN THE UNITED STATES AND ARIZONA 1/

Period	Copper Ore Shipped or Treated (Thousand Short Tons) 9/		Copper in Copper Ore (Recoverable Content) (Thousand Pounds) 10/		Worker Productivity			
	Ariz.	U.S.	Ariz.	U.S.	Copper Ore Mined per Man-hour (Tons)		Recoverable Copper Mined per Man-hour (Pounds)	
					Ariz.	U.S.	Ariz.	U.S.
1968	101,294	170,054	1,252,919	2,349,046	4.081	3.267	50.480	45.124
1969	127,849	223,752	1,593,544	3,021,590	3.984	3.455	59.656	46.655
1970	150,241	257,729	1,826,734	3,368,957	4.427	3.759	53.829	49.132
1971	149,294	242,656	1,633,568	2,986,599	4.544	4.059	49.725	49.996
1972	165,815	266,831	1,816,618	3,264,113	4.761	4.017	52.161	49.151
1973	173,605	289,998	1,847,635	3,386,357	4.872	3.912	48.530	45.683
1974	178,821	293,443	1,710,744	3,145,148	4.547	4.062	43.496	43.539
1975	168,656	263,003	1,619,535	2,772,111	4.694	4.543	45.076	47.885
1976	194,046	283,736	2,043,168	3,166,889	5.410	5.040	56.968	56.250
1977	168,601	259,974	1,843,949	2,964,539	5.379	4.815	58.824	54.905
1978	178,201	263,973	1,965,072	2,955,210	6.131	4.718	67.607	52.817

Source: Research & Analysis Section, Labor Market Information Group, Bureau of Employment and Training, Arizona Department of Economic Security; "Employment and Earnings," U.S. Department of Labor; "Minerals Yearbook - Metals, Minerals, and Fuels," U.S. Bureau of Mines.

TABLE XIV (Cont.)

EMPLOYMENT, EARNINGS AND HOURS IN COPPER MINING

IN THE UNITED STATES AND ARIZONA 1/

- 1/ Statistics do not reflect workers in copper smelting, refining and rod fabrication (See Table XIII for comparison).
- 2/ These figures are estimates made by the Arizona Department of Economic Security, in cooperation with the U.S. Bureau of Labor Statistics, and they include all full and part-time wage and salary workers who were employed in copper mining in any part of the pay periods which included the 12th of each month of the year.
- 3/ Estimates made by the U.S. Bureau of Labor Statistics, in cooperation with the 50 states, and based upon monthly samplings similar to those in 2/ above, adjusted periodically to census benchmarks.
- 4/ Estimates of production (non-supervisory) workers based upon samplings as in 2/ above. Since 1975 figures have been calculated by the Arizona Department of Mineral Resources dividing the annual number of "All Employees - Arizona" by a factor of 1.26. This factor was derived by comparing the annual number of "All Employees - Arizona" with "Production Workers - Arizona" from 1970 to 1974.
- 5/ Earnings figure for a particular year is the product of "Average Hourly Earnings" and "Average Weekly Hours" for that year.
- 6/ Gross payroll aggregates, exclusive of irregular bonuses and other pay not earned in a sample pay period, are divided by gross man-hour aggregates of production and related workers for the period in order to determine average hourly earnings.
- 7/ "Average Weekly Earnings" times 52 weeks.
- 8/ Number of production workers times "Average Weekly Hours" times 52 weeks.
- 9/ Copper ore mined and shipped or treated by concentration, smelting or leaching.
- 10/ Recoverable copper from copper ore (see 9/) and from copper precipitates produced from dump and in-place leaching. Prior to 1968 copper from precipitates was not included in this table or similar Department tables. The recoverable copper figure did, however, include an equivalent copper value of byproduct gold and silver; since 1968 no copper equivalents of any metal have been included.

TABLE XV

PROVEN COPPER RESERVES IN ARIZONA 1/

COMPANY	DEPOSIT	MAJOR MINERAL TYPE	MILLIONS OF TONS	AVERAGE CU CONTENT (%)	REMARKS
ANAMAX MINING COMPANY	Twin Buttes	Sulfide	322	0.67	With 0.30% Mo; cutoff @ 0.2% Cu
	"	"	300	0.80	Pub. 1973; "outside current mine plans"; cutoff @ 0.4% Cu
	"	Oxide	48	1.10	Cutoff @ 0.6% Cu
	"	"	28	0.49	Pub. 1973; cutoff @ 0.4% Cu
	Helvetia	Sulfide	320	0.64	Pub. 1973; cutoff @ 0.3% Cu
	"	Oxide	20	0.55	Pub. 1973; acid soluble Cu; cutoff @ 0.3% acid soluble Cu
	Peach Elgin	Mixed	23	0.75	Pub. 1973; cutoff @ 0.4% Cu
ASARCO INCORPORATED	Mission	Sulfide	98.215	0.76	
	Poston Butte	Mixed			
	Sacaton (OP)	Sulfide	17.057	0.71	
	Sacaton East (UG)	"	14.898	1.25	
	San Xavier	"	166.579	0.52	
	Silver Bell	"	24.227	0.66	
	"	Oxide			
AZTEC MINING CORPORATION	Mame	Oxide	2	1.00	Unpublished est.
BS & K MINING COMPANY	Atlas	Mixed			
CASA GRANDE COPPER COMPANY	Casa Grande	Mixed	350	1.00	

TABLE XV (Cont.)

PROVEN COPPER RESERVES IN ARIZONA 1/

COMPANY	DEPOSIT	MAJOR MINERAL TYPE	MILLIONS OF TONS	AVERAGE CU CONTENT (%)	REMARKS
CITIES SERVICE COMPANY	Cactus	Oxide	20	0.70	Unpublished est.
	Copper Cities	"		0.50	Pub. 1976
	Miami	"			
	Miami East	Mixed (?)	55	1.95	Pub. 1973
	Old Dominion	Sulfide			
	Pinto Valley	Sulfide	316	0.44	Pub. 1978; "recoverable Cu"
COCHISE DEVELOPMENT GROUP	Red Hill	Mixed			
	Bisbee- North	Mixed (?)	20	0.80	Unpublished est.
COCHISE MINING CORP.	San Juan	Oxide	20	0.50	Unpublished est.
CONTINENTAL OIL COMPANY	Poston Butte	Mixed	800	0.40	Pub. 1979
CRANE CO. (CF&I STEEL)	Dragoon	Oxide			
CYPRUS MINES CORP.	Bagdad	Sulfide	277	0.49	With 0.03% Mo
	"	Oxide	20	0.37	Acid soluble Cu
	"	"	97	0.19	Stockpile; acid soluble Cu after prior leaching
	Bruce	Sulfide	0.1276	3.73	Pub. 1976; with 12.8% Zn
	I-10	Mixed	100	0.52	Unpublished est.; with 0.02% Mo
	Johnson	Oxide	8.9	0.50	Acid soluble Cu
	"	Mixed	10	0.60	Pub. 1974
	Pima	Sulfide	147.483	0.497	
CYPRUS PIMA MINING CO.	Emerald Isle	Oxide	1.5	0.40	Pub. 1977; 3Mt @ 0.1% Cu
EL PASO COMPANY	Palo Verde (Anamax)	Sulfide	125	0.61	
EISENHOWER MINING CO.	Palo Verde (ASARCO)	Sulfide	31.5	0.70	
FREEMPORT MINERALS CO.	Santa Cruz	Mixed			

TABLE (Cont.)

PROVEN COPPER RESERVES IN ARIZONA 1/

COMPANY	DEPOSIT	MAJOR MINERAL TYPE	MILLIONS OF TONS	AVERAGE CU CONTENT (%)	REMARKS
HUDSON BAY MINING & SMELTING CO., LTD. (INSPIRATION)	Christmas (OP)	Sulfide	18.704	0.77	
	" (OP)	Oxide			
	" (UG)	Sulfide	20.131	1.78	Includes "probable" ore.
	Inspiration Area Mines	Mixed	254.957	0.58	
	Ox Hide	Oxide	29.867	0.31	Plus recoverable Cu remaining in leach pads.
KENNECOTT COPPER CORP.	Sanchez	Oxide	79.362	0.36	
	Chilito	Mixed			
	Ray	"	650	0.80	Reported 1977
	Safford	"	2000	0.41	"
	Safford Extension	"			
KERR-MCGEE CORPORATION	Red Mountain	Sulfide		0.71	Pub. 1970; 100Mt. possible
	Keystone Minerals Inc.	Oxide	8	0.50	Pub. 1973
MCALESTER FUEL COMPANY	Zonia	Oxide	20.5	0.53	Pub. 1977
	White Mesa	Oxide	2	0.75	Pub. 1955
NAVAJO TRIBE (?) NEWMONT MINING CORP.	Copper Creek	Sulfide			
	Kalamazoo	"			
	Magma	"	9.8	4.80	Reported 1978
	San Manuel	"	474	0.67	"
	"	Mixed	130	0.70	Pub. 1969
	Vekol Hills	Sulfide	105	0.56	Pub. 1978; minable by open pit; with 0.014% Mo; 16Mt oxide Cu
					With 0.29% MoS ₂ ;
NORANDA MINES LTD.	Four Metals	Sulfide	6.3	0.26	Reported 1965
	Ventura	"	3	0.82	Reported 1965
OCCIDENTAL PETROLEUM CO. ORACLE RIDGE MINING PARTNERS	Van Dyke	Oxide	100	0.50	Pub. 1977
	Oracle Redge	Mixed (?)	11	2.25	Reported 1977; with 0.64 oz Ag/ton (Pub. 1979)

TABLE XV (Cont.)
 PROVEN COPPER RESERVES IN ARIZONA 1/

COMPANY	DEPOSIT	MAJOR MINERAL TYPE	MILLIONS OF TONS	AVERAGE CU CONTENT (%)	REMARKS
S.B. OWENS	Carlota	Oxide	4	0.85	Reported 1979
PAPAGO TRIBE	Lakeshore	Sulfide (dissm)	241	0.70	Pub. 1969
	"	" (tactite)	23.6	1.69	"
	"	Oxide	207	0.71	"
PENNZOIL COMPANY (Duval Corp.)	Esperanza	Sulfide	21.850	0.28	With 0.029% Mo
	"	Oxide			
	Mineral Park	Sulfide	46.874	0.20	With 0.051% Mo
	"	Oxide			
	Sierrita	Sulfide	426.657	0.32	With 0.033% Mo
PHELPS DODGE CORPORATION	Copper Basin	Sulfide	175	0.55	Pub. 1974; minable by open pit; with 0.02% Mo
	Copper Queen	Mixed			
	Dos Pobres	Sulfide	400	0.72	Pub. 1977
	Lavender	"			
	Metcalf	"	415.970	0.77	Pub. 1975
	Morenci	"	662.462	0.80	"
	New Cornelia	"	126.623	0.63	"
	United Verde	"			
	"	Oxide			
RANCHERS EXPLORATION & DEVELOPMENT COMPANY	Bluebird	Oxide	60	0.50	As of June 30, 1979
	Old Reliable	"	4	0.74	Pub. 1973
V.B. SMITH ESTATE	Dynamite	Sulfide			
STANDARD METALS CORP.	Antler	Sulfide	5.1	1.95	With 4.13% Zn, 0.94% Pb, & 1.05 oz Ag/ton

TABLE XV (Cont.)

PROVEN COPPER RESERVES IN ARIZONA 1/

COMPANY	DEPOSIT	MAJOR MINERAL TYPE	MILLIONS OF TONS	AVERAGE CU CONTENT (%)	REMARKS
STRONG & HARRIS	Strong & Harris	Mixed	60	0.60	Unpublished est.; with 0.70% Zn
SUPERIOR OIL	Pine Flats	Sulfide	12	0.50	Unpublished est.
UNDETERMINED	Mineral Hill	Mixed			
UNION OIL	Turquoise	Oxide	10	0.50	Pub. 1975
UNITED STATES GOVERNMENT	Park Hill	Mixed (?)	30	0.45	Unpublished est.
UNITED STATES GOVERNMENT & U.S. METALS CORP.	Apex	Mixed (?)			

Source: Company Annual Reports, Form 10-K's, and Prospectus; Professional Publications.

1/ Reserves are given with a grade of average total copper content as of December 31, 1978, unless stated otherwise under "Remarks." As used in this table, reserves generally mean those estimated quantities of ore which under presently and reasonably foreseen technical and economic conditions may be profitably mined and sold or processed for the extraction of their constituent values.

* COPPER RESERVES OF ARIZONA

ANAMAX MINING CO.

1. Twin Buttes
2. Helvetia
3. Peach Elgin

ASARCO INC.

4. Mission
5. Poston Butte
6. Sacaton
7. Sacaton East
8. San Xavier
9. Silver Bell

AZTEC MINING CO.

10. Mame

BS & K MINING CO.

11. Atlas

CASA GRANDE COPPER CO.

12. Casa Grande

CITIES SERVICE CO.

13. Cactus
14. Copper Cities
15. Miami
16. Miami East
17. Old Dominion
18. Pinto Valley
19. Red Hill

COCHISE DEVELOPMENT GROUP

20. Bisbee - North

COCHISE MINING CORP.

21. San Juan

CONTINENTAL OIL CO.

22. Poston Butte

CRANE CO. (CF&I)

23. Dagoon

CYPRUS MINES CORP.

24. Bagdad
25. Bruce
26. I-10
27. Johnson

CYPRUS PIMA MINING CO.

28. Pima

EL PASO CO.

29. Emerald Isle

EISENHOWER MINING CO.

30. Palo Verde

FREEMONT MINERALS CO.

31. Santa Cruz

HUDSON BAY MINING & SMELTING CO., LTD. (INSPIRATION)

32. Christmas
33. Inspiration Area Mines
34. Ox Hide
35. Sanchez

KENNECOTT COPPER CORP.

36. Chilito
37. Ray
38. Safford
39. Safford Extension

KERR-MCGEE CORP.

40. Red Mountain

KEYSTONE MINERALS INC.

41. Korn Kob

McALESTER FUEL CO.

42. Zonia

NAVAJO TRIBE (?)

43. White Mesa

NEWMONT MINING CORP.

44. Copper Creek
45. Kalamazoo
46. Magma (Superior)
47. San Manuel
48. Veko1 Hills

NORANDA MINES LTD.

49. Four Metals
50. Ventura

OCCIDENTAL PETROLEUM CO.

51. Van Dyke

ORACLE RIDGE MINING PARTNERS

52. Oracle Ridge

S. B. OWENS

53. Carlota

PAPAGO TRIBE

54. Lakeshore

PENNZOIL CO. (DUVAL)

55. Esperanza
56. Mineral Park
57. Sierrita

PHELPS DODGE CORP.

58. Copper Basin
59. Copper Queen
60. Dos Pobres
61. Lavender
62. Metcalf
63. Morenci
64. New Cornelia
65. United Verde

RANCHERS EXPLORATION & DEVELOPMENT CO.

66. Bluebird
67. Old Reliable

V.B. SMITH ESTATE

68. Dynamite

STANDARD METALS CORP.

69. Antler

STRONG & HARRIS

70. Strong & Harris

SUPERIOR OIL

71. Pine Flats

UNDETERMINED

72. Mineral Hill

UNION OIL

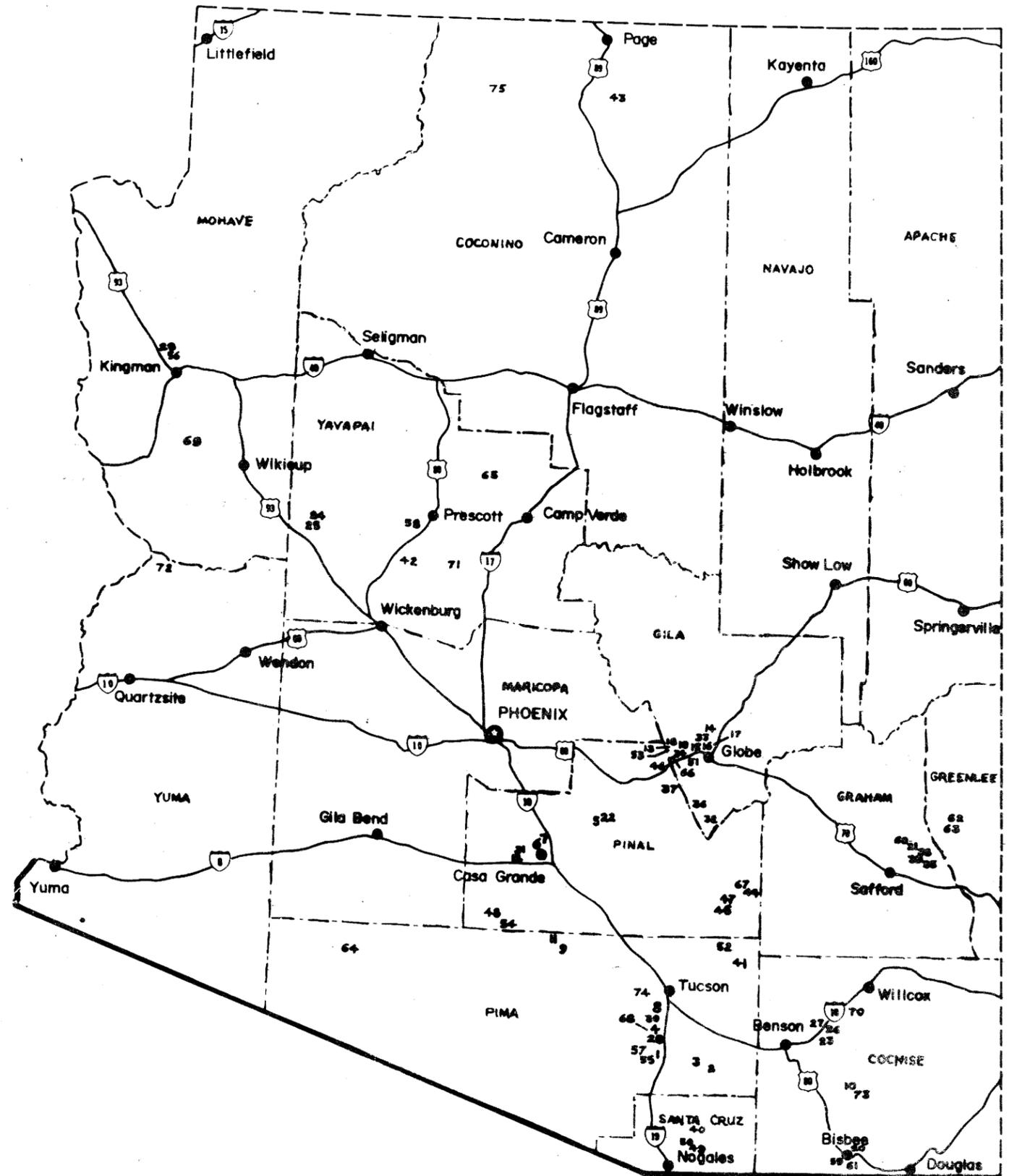
73. Turquoise

UNITED STATES GOVERNMENT

74. Park Hill

UNITED STATES GOVERNMENT & U. S. METALS CORP.

75. Apex



*Ownership data is based on best source available to the Department as of 12/31/78 and is subject to revision or change.

ARIZONA DEPARTMENT OF MINERAL RESOURCES

The Department was created to aid in the promotion, development, and conservation of the mineral resources of the State. Particular emphasis is placed on providing prospectors and small miners with semi-technical assistance and economic information.

The general goal of the Department is developed by working with the following objectives:

- Provide technical assistance to prospectors and operators of small mines.
- Disseminate comprehensive mining and mineral information to the citizens and government officials of Arizona counties.
- Study conditions regarding small mine activity and seek solutions to problems.
- Serve as the State's public bureau of mining and mineral information.
- Maintain and expand the Department's mine file library.
- Provide educational services in the field of mineral resources and mining.
- Analyze proposed Federal and State administrative actions.
- Develop interagency cooperation between the Department and other local State and Federal offices.
- Gather all information available on mineral occurrences, prospects, partially developed properties and known mines in the State in order to promote further exploration.
- Provide publications in the form of mineral reports, annual directories, technical reports, annual mineral industry surveys, information circulars, and media articles.