

THE PRIMARY COPPER INDUSTRY OF ARIZONA IN 1992



DEPARTMENT OF MINES AND MINERAL RESOURCES

BY N. J. Niemuth

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by N.J. Niemuth

Department of Mines and Mineral Resources

Special Report No. 20



State of Arizona
Fife Symington, Governor

Phoenix, Arizona
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Table 23. Historic Arizona and U.S. copper mine production

[Copper reported in tons]						
Period	Arizona production	Arizona cumulative	U.S. production	U.S. cumulative	AZ's % of U.S. Production Period	Cummulative
1874-1971(1)	24,889,171	24,889,171	60,365,183	60,365,183	41.2	41.2
1972	847,929	25,737,100	1,664,840	62,030,023	50.9	41.5
1973	867,506	26,604,606	1,717,940	63,747,963	50.5	41.7
1974	804,904	27,409,510	1,597,002	65,344,965	50.4	41.9
1975	751,489	28,160,999	1,413,366	66,758,331	53.2	42.2
1976	956,215	29,117,214	1,605,586	68,363,917	60.0	42.6
1977	852,620	29,969,834	1,503,964	69,867,887	56.7	42.9
1978	908,835	30,878,669	1,496,482	71,364,363	60.7	43.3
1979	957,251	31,835,920	1,591,200	72,955,563	60.2	43.6
1980	760,926	32,596,846	1,301,900	74,257,463	58.4	43.9
1981	1,071,949	33,668,795	1,695,500	75,952,963	63.2	44.3
1982	848,750	34,517,545	1,264,322	77,217,285	67.1	44.7
1983	747,604	35,265,149	1,144,306	78,361,591	65.3	45.0
1984	822,815	36,087,964	1,215,400	79,576,991	67.7	45.3
1985	878,044	36,966,008	1,218,900	80,795,891	72.0	45.8
1986	878,926	37,844,934	1,180,564	81,976,455	74.4	46.2
1987	862,034	38,706,968	1,384,394	83,360,849	62.3	46.4
1988	942,556	39,649,524	1,584,115	84,944,964	59.5	46.7
1989	1,004,891	40,654,415	1,651,501	86,596,465	60.8	46.9
1990	1,087,287	41,741,702	1,738,952	88,335,417	62.5	47.3
1991	1,132,536	42,874,238	1,797,965	90,133,382	63.0	47.6
1992	1,271,466	44,006,774	1,945,602	92,078,984	65.4	47.8

1) For cumulative breakdown 1874-1911 and annual production 1912-1971, see Phillips, K., 1973, "The Copper Industry," Arizona Department of Mines and Mineral Resources.

Source: "Minerals Yearbook - Area Reports: Domestic," U.S. Bureau of Mines; Table 1, this publication.

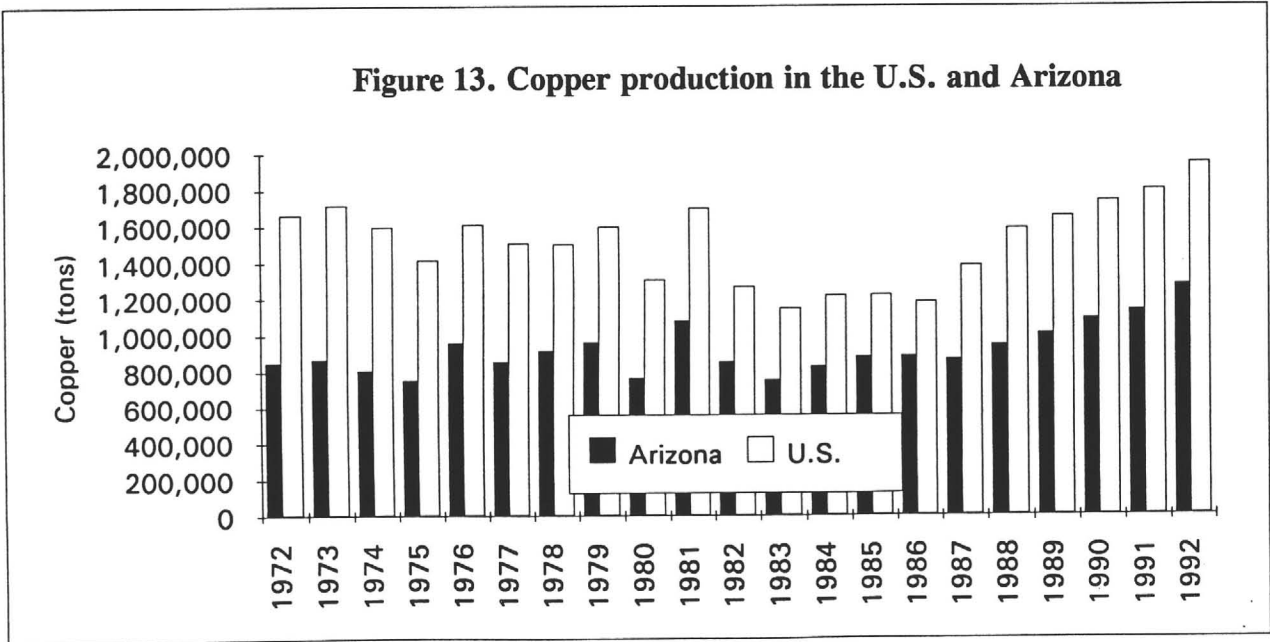


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* Throughout this report a "ton" means a short ton (2,000 pounds or 0.90718 metric ton). Specific statistics may vary slightly from table to table due to differences in source data.

Table 22. Copper reserve base in 1992 — continued

Deposit Location	Company	Mineral type	Million tons	% Cu	Source/comments
United Verde T16N R2E S. 22	Phelps Dodge Corp.	Sulfide	21.0	0.5	U.S. Geological Survey Bulletin 1857D. With 6.6 0.61 oz/ton Ag and 0.02 oz/ton Au.
Van Dyke T1N R15E S. 30	Arimetco International Inc.	Acid Soluble	100.0	0.53	Arimetco International annual report, 1992.
Vekol hills T10S R3E S. 4	Tohono O'odham Tribe	Sulfide	105.0	0.6	Vekol Hills Project EIS, U.S. Interior Dept. 1988. With 0.014% Mo, 16 million tons acid soluble.
Ventura T23S R15E S. 1	Cyprus Copper Co.	Sulfide	6.0	0.3	Iso Mines Ltd. annual report, 1965. With 0.28% MoS ₂ , 6 million additional tons possible.
White Mesa T38N R9E S. 29	Mesa Mining	Acid Soluble	25.0	0.3	Unpublished geologic estimate. Additional tonnage likely.
Zonia T11N R4W S. 12	Arimetco International Inc.	Acid Soluble	30.0	0.4	Arimetco International annual report, 1992.
Total copper reserve base in Arizona					
Sulfide			8,107.7	0.53	contains 43.034 million tons of copper
Acid Soluble			5,348.6	0.39	contains 20.790 million tons of copper
Mixed			1,050.8	0.68	contains 7.193 million tons of copper
Total			14,507.1	0.49	contains 71.017 million tons of copper

Company index to copper reserve base

Company	Deposit	Company	Deposit
Arimetco International	Emerald Isle	Kerr McGee Corp.	Red Mountain
Arimetco International	Johnson	Keystone Minerals	Korn Kob
Arimetco International	Van Dyke	Lodestar Minerals	Gibson
Arimetco International	Zonia	Magma Copper	Copper Creek
Asarco & Freeport	Casa Grande	Magma Copper	Kalamazoo
Asarco & Freeport	Santa Cruz	Magma Copper	Miami East
Asarco Inc.	Atlas	Magma Copper	Miami Tailings
Asarco Inc.	Buckeye East	Magma Copper	Pinto Valley
Asarco Inc.	Chilito	Magma Copper	Poston Butte
Asarco Inc.	Copper Butte	Magma Copper	San Manuel OP
Asarco Inc.	Helvetia	Magma Copper	San Manuel UG
Asarco Inc.	Mission	Magma Copper	Superior
Asarco Inc.	Peach Elgin	Mesa Mining	White Mesa
Asarco Inc.	Ray	Oracle Ridge	Oracle Ridge
Asarco Inc.	Sacaton East	Orcana Resources	Sheep Mtn.
Asarco Inc.	Silver Bell	Phelps Dodge	Cochise
AZCO Mining Inc.	Sanchez	Phelps Dodge	Copper Basin
AZCO Mining Inc.	Strong & Harris	Phelps Dodge	Copper Queen
Cambior USA Inc.	Carlota	Phelps Dodge	Dos Pobres
Challinor, John	Swansea	Phelps Dodge	Lone Star
Claridge, Alf, et al	San Juan	Phelps Dodge	Morenci
Corn, Russ	Lonesome Pine	Phelps Dodge	New Cornelia
Cyprus Copper	Bagdad	Phelps Dodge	United Verde
Cyprus Copper	Casa Grande	Rayrock Mines	Kay Copper
Cyprus Copper	Christmas	Santa Fe Pacific	Turquoise
Cyprus Copper	Esperanza	Smith, Addison	Dynamite
Cyprus Copper	Miami	Squaw Peak	Squaw Peak
Cyprus Copper	Mineral Park	Standard Metals	Antler
Cyprus Copper	Sierrita	Sullivan, James	Dragoon
Cyprus Copper	Ventura	Sullivan, James	I-10.
Duerr & Prochnav	Four Metals	Tohono O'odham	Vekol hills
Dugan Production	Two Peaks	U.S. Government	Mineral Butte
Heinrichs GEO	Stray Elephant	Unknown	Iron Door
Hope Mining	Mame		

Table 22. Copper reserve base in 1992 — continued

Deposit Location	Company	Mineral type	Million tons	% Cu	Source/comments
Sacaton East T5S R5E S. 26	Asarco Inc.	Sulfide	15.0	1.3	Asarco form 10-K, 1979. Underground.
San Juan T5S R26E S. 35	Clardige, Alf et al	Acid Soluble	15.5	0.5	Producers Minerals Corp. Report June, 1975. At 0.35% Cu cutoff.
San Manuel OP T8S R16E S. 35	Magma Copper Co.	Acid Soluble Acid Soluble Sulfide	22.1 2.9 0.3	0.4 0.2 0.96	Magma Copper form 10-K, 1992. Open pit marginal.
San Manuel UG T8S R16E S. 34	Magma Copper Co.	Sulfide Acid Soluble Sulfide	63.0 196.8 142.0	0.7 0.4 0.6	Magma Copper form 10-K, 1992. In-situ. 50% recovery anticipated. Magma Copper form 10-K, 1990. Additional mineralization in shaft pillar.
Sanchez T6S R27E S. 25	AZCO Mining Inc.	Acid Soluble Acid Soluble	168.0 23.0	0.3 0.2	AZCO report, 1992. Reseve and low grade suitable for leaching.
Santa Cruz T6S R4E S. 13	Asarco & Freeport McMoran	Acid Soluble	800.0	0.4	U.S. Bureau of Mines data, 1985.
Sheep Mtn. T8N R1W S. 15	Orcana Resources Ltd.	Sulfide	39.0	1.27	"Preliminary economic evaluation ..." by Watts Griffis and McOuat, 1992. Supergene only.
Sierrita T18S R12E S. 7	Cyprus Copper Co.	Sulfide	980.6	0.29	With 0.032% Mo. Cyprus Minerals form 10-K, 1992. Reserve includes Twin Buttes deposit.
Silver Bell T12S R8E S. 11	Asarco Inc.	Sulfide	101.0	0.5	Asarco annual report, 1992.
Squaw Peak T13N R5E S. 29	Squaw Peak Copper Co.	Sulfide	20.0	0.4	Roe, Robert R., 1976 report.
Superior T1S R12E S. 35	Magma Copper Co.	Sulfide Sulfide	1.3 2.6	4.97 5.70	Magma Copper form 10-K,1992. Current reserve. Form 10-K,1991. Additional uneconomic tonnage.
Stray Elephant T4N R20W S. 31	Heinrichs GEO Exploraton Co.	Mixed	2.0	0.6	Reported by James Loughry. Additional 5M tons of 0.5% possible.
Strong & Harris T15S R22E S. 13	AZCO Mining Inc.	Mixed	60.0	0.60	Unpublished estimate with 0.70 Zn.
Swansea T10N R15W S. 32		Mixed	5.5	0.81	Wilkins, J., 1990, private report.
Turquoise T19S R25E S. 17	Santa Fe Pacific Mining Inc.	Acid Soluble Mixed	15.0 1.0	0.50 3.10	Santa Fe property synopsis 1992. With 0.05 oz/ton Au. Underground.
Two Peaks T19S R19E S. 20	Dugan Production	Sulfide	32.0	0.3	U.S. Geological Survey Professional Paper 1300, page 128.

INTRODUCTION

The Arizona Department of Mines and Mineral Resources presents herein a report covering activity in Arizona's copper industry in the calendar year 1992. A brief review of operational highlights reported by the major producers and developers in the State, market and price developments that affected copper production, and discussions of Arizona severance taxes on metalliferous minerals are included.

The contained statistical tables include various production, employment, inventory, import/export, prices, costs, and ore reserve numbers for 1992. Production of recoverable copper is given for individual mines and by company. Figures showing the importance of copper in the mining industry are provided, as are data on the by-products of copper mining; gold, silver, and molybdenum. In addition, historical compilations are included for leach copper, average grade of ore produced, percent copper recovered, stripping ratios, and employment and earnings. Additional compilations indicating refined copper inventories in and out of the United States and average copper prices by month from 1982 through 1992 are provided. Also included are tables showing designed mine capacity and copper reserve base in Arizona plus cash production costs for the United States, 1983-1990.

The Department maintains an extensive reference library concerning the copper industry in Arizona. This repository includes information on individual mines and mining companies, United States Bureau of Mines and United States Geological Survey publications, other professional publications, periodicals, and earlier editions of this report. Additionally, experienced mining engineers are available for consultation, at no charge, on matters germane to the minerals industry.

The author wishes to express his sincere appreciation to the management and staff of Arizona's mining companies for graciously devoting time and effort to provide information for this report. Jean Dupree and Dan Edelstein of the U.S. Bureau of Mines, Dr. George Leaming of the Western Economic Analysis Center of Marana, Arizona, and the American Bureau of Metal Statistics, Inc. of Secaucus, New Jersey also provided vital information. Thanks are also due to the Arizona Department of Economic Security, the Arizona Department of Revenue, and the staff of the Joint Legislative Budget Committee for providing data and statistics.

A special gratitude is felt toward the preceding authors for providing the format and sources of statistical information and to H. Mason Coggin, Director of the Department of Mines and Mineral Resources, for providing the opportunity to author this report.

COPPER PRODUCTION IN ARIZONA - 1992

Arizona's copper industry produced 2.54 billion pounds of copper in 1992 (Table 1). This is an increase of 12.3 percent above 1991, and is the highest annual production ever achieved. Arizona contributed 65.4 percent of U.S. copper production, up from 63 percent in 1991 (Table 23).

The gross value of non-fuel mineral production in Arizona in 1992 was up 10.0 percent from 1991 to \$3.16 billion (Table 10) reflecting increased copper production. Copper represents 85.2 percent of this total; gold, silver and molybdenum by-products of copper production represent an additional 3.4 percent (Table 9). The total contribution of the copper mines was therefore 88.6 percent of the gross value.

Copper was produced by 6 companies from 18 properties in 1992, and molybdenum was recovered as a co-product or by-product at 6 of these properties (Tables 3 and 4). Ten properties produced 98.0 percent of Arizona's copper, and 3 produced 90.0 percent of the molybdenum. The Morenci Mine of Phelps Dodge led in copper production with 30.6 percent of the total. Cyprus' Sierrita Mine produced 45.2 percent of the molybdenum. Concentrate production increased 9.6% to 1.767 billion pounds. Copper produced by leaching increased even more, 16.2% over 1991 to more than 775 million pounds and represents 30.5 percent of total production. (Table 1).

Figure 1. Producing copper properties - 1992

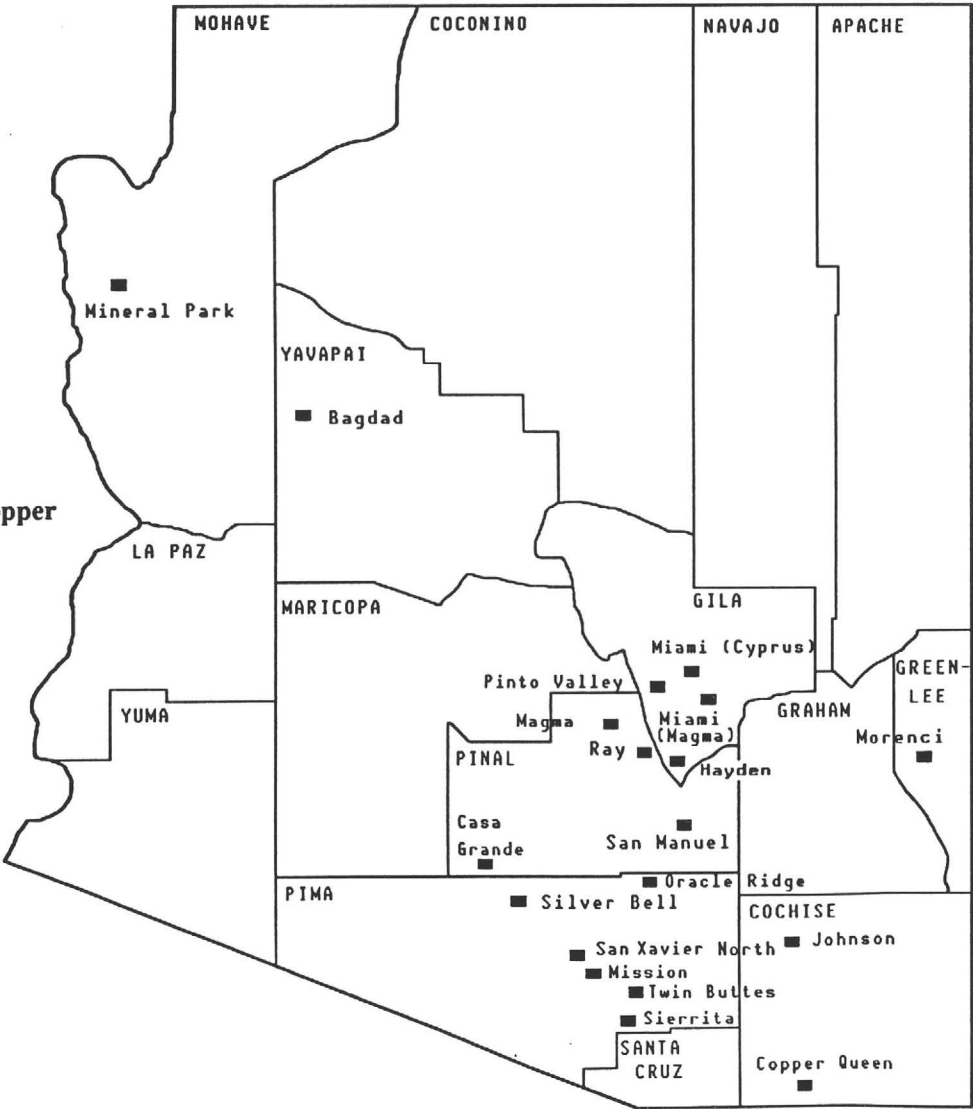


Table 22. Copper reserve base in 1992 — continued

Deposit Location	Company	Mineral type	Million tons	% Cu	Source/comments
Mame T19S R25E S. 20	Hope Mining & Milling Co.	Acid Soluble	1.4	1.10	Unpublished estimate.
Miami T1N R14E S. 25	Cyprus Copper Co.	Acid Soluble	320.0	0.44	Cyprus Minerals form 10-K, 1992. Includes proven and probable reserves.
Miami East/Miami T1N R15E S. 19	Magma Copper Co.	Sulfide Sulfide Mixed	6.0 50.0	3.14 1.95	Newmont Mining annual report, 1985. USBM Minerals Yearbook 1973, Area Reports. Unquantified. In situ production 10MM lb.annually
Miami Tailings T1N R15E S. 30	Magma Copper Co.	Acid Soluble	25.2	0.4	Magma form 10-K, 1992. 54% recovery expected.
Mineral Butte T4S R7E S. 1	U.S. Government	Mixed	14.6	0.4	Withdrawn from mineral entry.
Mineral Park T23N R17W S. 19	Cyprus Copper Co.	Acid Soluble	14.4	0.24	Cyprus Minerals form 10-K, 1992.
Mission T16S R12E S. 31	Asarco Inc.	Sulfide	564.9	0.67	Asarco annual report, 1992. With 0.14 oz/ton silver.
Morenci T4S R29E S. 16	Phelps Dodge (85%) and Sumitomo (15%)	Sulfide Acid Soluble Sulfide Acid Soluble	583.0 861.2 150.0 180.0 300.0	0.76 0.3 0.72 0.71 0.29	Phelps Dodge annual report, 1992. Milling reserve Leaching reserves. Western Copper. Coronado deposit. Coronado deposit.
New Cornelia T12S R6W S. 27	Phelps Dodge Corp.	Sulfide	160.0	0.56	Phelps Dodge annual report, 1992.
Oracle Ridge T11S R16E S. 16	Oracle Ridge Mining Partners	Mixed	4.0	2.23	South Atlantic Ventures annual report,1990. With 0.67 oz/ton Ag. Additional 4.4 million tons poss.
Peach Elgin T18S R15E S. 15	Asarco Inc.	Mixed	46.0	0.6	SME Preprint 92-61 by Anzalone and Brown. With 0.3% cutoff. Mineralization is 60% sulfides.
Pinto Valley T1N R14E S. 2	Magma Copper Co.	Sulfide Sulfide Sulfide Sulfide	154.5 445.0 146.4 48.8	0.37 0.12 0.42 0.20	Magma form 10-K, 1992. Milling reserve. Dump leach reserve. Magma form 10-K, 1991. Milling resource. Magma form 10-K, 1991. Dump leach resource.
Poston Butte T4S R9E S. 33	Magma Copper Co.	Sulfide Acid Soluble	500.0 300.0	0.39 0.4	Magma "Copper Sense," August, 1992.
Ray T3S R13E S. 10	Asarco Inc.	Sulfide	1120.0	0.63	Asarco annual report, 1992.
Red Mountain T22S R16E S. 20	Kerr McGee Corp.	Sulfide	100.0	0.71	Tucson Daily Citizen, Sept. 23, 1970.

Table 22. Copper reserve base in 1992 — continued

Deposit Location	Company	Mineral type	Million tons	% Cu	Source/comments
Copper Queen T23S R24E S. 9	Phelps Dodge Corp.	Mixed	1.0	5.50	Phelps Dodge prospectus, May 8, 1975. Underground, contains significant gold resource.
Dos Pobres T5S R26E S. 27	Phelps Dodge Corp.	Sulfide UG Mixed OP	230.0 270.0	0.9 0.5	Phelps Dodge annual report, 1992. Open pit reserves are recoverable by leaching.
Dragoon T16S R22E S. 25	Sullivan, James	Acid Soluble	25.0	0.50	Unpublished estimate.
Dynamite T17S R13E S. 30	Smith, Addison	Mixed	100.0	0.53	Unpublished estimate.
Emerald Isle T23N R18W S. 22	Arimetco International Inc.	Acid Soluble	1.8	0.72	Arimetco International annual report, 1991.
Esperanza T18S R12E S. 16	Cyprus Copper Co.	Sulfide	48.0	0.27	Pennzoil form 10-K, 1981. With 0.034% Mo.
Four Metals T23S R16E S. 20	Duerr & Prochnav	Sulfide	14.0	0.7	Personal communication.
Gibson T1S R14E S. 21	Lodestar Minerals Inc.	Acid Soluble	10.8	0.7	Fletcher, J.B. et al report August, 1984. Geologic potential.
Helvetia T18S R15E S. 36	Asarco Inc.	Sulfide Acid Soluble	362.0 66.0	0.61 0.53	SME Preprint 92-61 by Anzalone and Brown. Sulfide includes 0.25 oz/ton Ag and 0.016% Mo.
I-10 T15S R23E S. 31	Sullivan, James	Mixed	100.0	0.52	Unpublished estimate; with 0.02% Mo.
Iron Door T13S R25E S. 17	Unknown	Sulfide	63.0	0.4	Spike-E Hills Report. Cutoff at 0.20% Cu.
Johnson T15S R22E S. 26	Arimetco International Inc.	Acid Soluble Acid Soluble	4.0 12.0	0.40 0.2	Arimetco International annual report, 1992. Burro Chief deposit. Copper Chief deposit.
Kalamazoo T9S R16E S. 9	Magma Copper Co.	Sulfide Sulfide	17.0 143.0	0.72 0.71	Magma Copper form 10-K, 1992. Resource below 2950 level of deposit.
Kay Copper T8N, R2E, S. 4	Rayrock Mines Inc.	Sulfide	6.0	2.20	Northern Mines Handbook 1990-1. With 3% Zn, 1.6 oz/ton Ag and 0.08 oz/ton Au.
Korn Kob T12S R17E S. 14	Keystone Minerals Inc.	Acid Soluble	18.0	0.40	Reported by Keystone Minerals from 1990 drilling by A. F. Budge.
Lone Star T6S R27E S. 5	Phelps Dodge Corp.	Acid Soluble	1600.0	0.38	Phelps Dodge annual report, 1992.
Lonesome Pine T1S R14E S. 14	Corn, Russ	Mixed	20.0	0.4	Geologic potential based on partially tested chalcocite/oxide zone.

The weighted average grade of sulfide ore mined in 1992 was 0.53 percent copper (Table 6). Stripping of waste, including some leachable material, was accomplished at the 11 operating open pit mines during 1992. The weighted average of the stripping ratios - waste to ore - was 1.26 to 1 (Table 8). Compared to the 1.49 to 1 in 1991 this decline probably indicates some reduction in stripping and possibly a change in designation of some waste to leach ore.

The estimated capacity to produce copper at each of Arizona's principal operations totals 1.383 million tons annually (Table 11). By this estimate the mines, concentrators, and leach facilities operated at 91.9 percent of capacity in 1992.

The copper reserve base in Arizona is estimated to be over 14.5 billion tons containing over 71 million tons of copper (Table 22). This represents an 11.5 percent increase in tonnage and a 6 percent increase in contained copper compared to 1991 figures. The increases occurred largely at presently producing properties, not new discoveries. At present mining rates, this amount, if economic, would represent 49.8 years of reserves.

1992 OPERATIONS SUMMARY

Operating properties	18
Operating companies	6
Operating smelters	3
Ore mined (including some oxide)	291,295,132 tons
Ore milled (sulfides)	192,860,212 tons
Waste/overburden removed (includes some leach material)	340,940,509 tons
Average stripping ratio	1.26:1 (waste:ore)
Copper produced	1,271,466 tons - 65.4% of U.S.
From sulfide ores	883,544 tons - 69.5% of AZ
Average sulfide grade	0.53% copper
From leaching	387,922 tons - 30.5% of AZ
By SX-EW	381,386 tons - 98.3% of leached
Molybdenum produced	30,770,172 pounds
Silver produced	5,015,702 troy ounces
Gold produced	60,089 troy ounces
Average employment	12,508
Average annual wage	\$40,012
Productivity (production workers)	123.9 pounds of copper per man-hour 15.9 tons of ore per man-hour

STATUS AND PROGRESS

Although the world recession continued, copper prices declined only slightly. The average price for 1992 was 107.423 cents per pound (U.S. Producer Cathode) according to Metals Week, down less than 2 cents compared with 1991. World warehouse inventories rose by almost 25 percent during the year, while inventories in U.S. warehouses and refineries increased nearly 80 percent. Production of copper on a worldwide basis continued to grow, as it did in the U.S. and Arizona. Despite the negative factors that would create gloom for the immediate future, prices held firm through the end of the year. The growth in the production of copper by SX-EW, along with other capital improvements, enabled Arizona producers to keep their production costs low, and therefore generally profitable, as well as competitive with producers in the rest of the world.

Major companies continued to increase production by investing in their producing properties as opposed to opening new mines. The resulting expansions and efficiency improvements accounted for most of the production increases.

Smaller companies were more aggressive in their efforts to bring new copper projects on stream. Arimetco began operation in July of a new heap leach SX-EW facility at the Emerald Isle Mine. Arimetco acquired a lease on the Zonia deposit and continued development at the Van Dyke Mine. AZCO continued the process of financing and permitting to bring the Sanchez Mine in Graham County to production. Construction of a new SX-EW plant may begin in late 1994 if permitting is completed. Cambior USA began mine planning and permitting after completing a drilling program at the Carlota deposit that delimited over 100 million tons of copper oxide mineralization.

OPEN PIT MINING

Open pit mining is the principal method of producing copper ore. Loading equipment ranges from front-end loaders to 50 cubic yard electric shovels. Haulage is by off-road trucks with up to 240 ton capacity, increasingly in conjunction with conveyor belts. The installation of in-pit crushing facilities along with conveyor systems to transport ore to the mills has been a major factor in the reduction of operating costs. The high capital investment required to install these systems is absorbed by the long life of the operations.

In 1992, 12 open pits were mined. Seven produced both sulfide and oxide ore, while 2 produced only sulfide ore, and 3 produced principally oxide ore.

UNDERGROUND MINING

The San Manuel Mine of Magma Copper is the largest underground metal mine in the nation and utilizes the block-caving method of mining. This method consists of undercutting a block of ore and allowing the ore to cave into draw points to be loaded onto trains for haulage to the shaft and hoisted to the surface. Nearly 20 million tons of sulfide ore were hoisted in 1992.

Magma's historic Superior Mine produced 250,500 tons of high grade ore utilizing the undercut and fill method of ore extraction.

Oracle Ridge Mining Partners mined nearly 200,000 tons of ore from the Oracle Ridge Mine mainly by use of the room and pillar method.

IN SITU MINING

In situ leaching of rubbleized copper bearing material remaining in previously mined underground stopes has long been practiced in Arizona. At San Manuel, Magma has developed a formal program of leaching mined out block caving stopes. With a production of nearly 24 million pounds, it was the largest in situ producer. During the past several years all of the production from the Casa Grande Mine has been from a similar system developed by Noranda. Cyprus is continuing this project as well as tests of in situ leaching of non-rubbleized or virgin ground.

The U.S. Bureau of Mines continues development of technology to in situ leach virgin ground and is partially funding research at the Santa Cruz deposit near Casa Grande. The ore body, a deep seated acid soluble deposit, is owned by Asarco and Freeport-McMoran on a 50-50 basis.

SOLVENT EXTRACTION

Historically, copper produced from leach solutions had been extracted by the cementation process that precipitated copper from solution by replacement with metallic iron. This was an inexpensive method, but the cement copper produced had to be smelted and refined.

During the 1960's, Ranchers Exploration and Development Corporation pioneered the use of SX-EW to produce copper at its Bluebird property near Miami. The obvious advantage of this method is that cathode copper of salable quality could be produced directly from leach solutions. The expense of smelting and refining is avoided.

During the years after Rancher's introduction of SX-EW, interest in the process grew gradually. The

Table 22. Copper reserve base in 1992

[Reserve base is that part of an identified resource that meets specified minimum physical and chemical criteria related to current mining and production practices, including those for grade, quality, thickness, and depth. The reserve base is the in-place demonstrated (measured plus indicated) resource from which reserves are estimated. It may encompass those parts of the resources that have a reasonable potential for becoming economically available within planning horizons beyond those that assume proven technology and current economics. The reserve base includes those resources that are currently economic (reserves), marginally economic (marginal reserves), and some of those that are currently subeconomic (subeconomic resources). Definition from "Mineral Facts and Problems" 1985 edition, U.S. Bureau of Mines, Bulletin 675, page 3]

Deposit Location	Company	Mineral type	Million tons	% Cu	Source/comments
Antler T17N R16W S. 4	Standard Metals Corp.	Sulfide	5.0	1.95	Annual report & form 10-K, 1987. With 4.13% Zn, 0.94% Pb, and 1.05 Ag oz/ton. An additional 2.5 million tons reported in 1979 annual report.
Atlas T11S R8E S. 32	Asarco Inc.	Sulfide Acid Soluble Sulfide Acid Soluble	5.4 4.9 18.9 12.1	0.64 0.4 0.7 0.4	"Report on the BS&K Project" by Buchella, F. Sulfide cutoff 0.40%. Acid Soluble cutoff 0.20%. Asarco property adjacent to Atlas. Asarco property adjacent to Atlas.
Bagdad T14N R9W S. 4	Cyprus Copper Co.	Sulfide	1231.0	0.37	Cyprus Minerals form 10-K, 1992. Includes proven and probable. With 0.022% Mo.
Buckeye East T3S R12E S. 26	Asarco Inc.	Acid Soluble	20.0	0.65	"Arizona Wilderness 1988", Arizona Mining Association, Report A-23. 40 million possible.
Carlota T1N R13E S. 36	Cambior USA Inc.	Acid Soluble	106.0	0.45	Cambior's Carlota fact sheet August, 1993. Includes Cactus and Eder deposits.
Casa Grande T6S R5E S. 18	Asarco & Freeport McMoran JV.	Mixed	352.0	1.00	Getty Oil Co. annual report, 1980. With 0.01% Mo. Cutoff at 0.5% Cu.
Casa Grande (Lakeshore) T10S R4E S. 25	Cyprus Copper Co.	Sulfide Sulfide Acid Soluble	41.0 9.0 15.5	0.71 1.35 0.76	Porphyry - Noranda annual report, 1984. Tactite - Noranda annual report, 1984. Cyprus Minerals form 10-K, 1992.
Chilito T4S R15E S. 22	Asarco Inc.	Mixed	74.7	0.51	Chilito Mines Report. With 0.01% Mo and 0.04 oz/ton Ag.
Christmas T4S R16E S. 30	Cyprus Copper Co.	Sulfide Sulfide	7.0 20.0	0.63 1.82	Inspiration Resources form 10-K, 1983. Open pit. Underground.
Cochise T23S R24E S. 9	Phelps Dodge Corp.	Acid Soluble	210.0	0.40	Phelps Dodge annual report, 1992.
Copper Basin T13N R3W S. 20	Phelps Dodge Corp.	Sulfide	70.0	0.5	Phelps Dodge annual report, 1992. With 0.021% Mo.
Copper Butte T3S R13E S. 30	Asarco Inc.	Acid Soluble	22.0	1.1	"Arizona Wilderness 1988," Arizona Mining Association, Report A-23.
Copper Creek T8S R18E S. 11	Magma Copper Co.	Sulfide	80.0	0.55	Unpublished estimate.

Table 21. Estimated copper production costs for the United States

[Cents per pound of copper. Data may not add to totals shown due to rounding. (na), not available]

Product costs	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Mine operating cost	22	20	23	23	19	18	17	17	na	na
Mill-float operating cost (2	24	23	20	21	28	28	27	27	na	na
Mill-leach operating cost	7	7	(3	(3	(3	(3	(3	(3	na	na
Smelt/refine/transportation	26	24	23	19	14	17	18	18	na	na
Taxes (4	3	2	2	2	2	1	1	1	na	na
Total cost	82	76	68	65	63	64	63	63	na	na
Byproduct credits	-13	-11	-9	-9	-10	-10	-9	-10	na	na
Cash cost (5	69	65	59	56	53	54	54	53	na	na
Recovery of capital	na	na	na	11	5	7	6	6	na	na
Total	na	na	na	67	58	61	60	60	na	na

(1 Includes 18 mines, most of which were producing from 1983 to 1990.

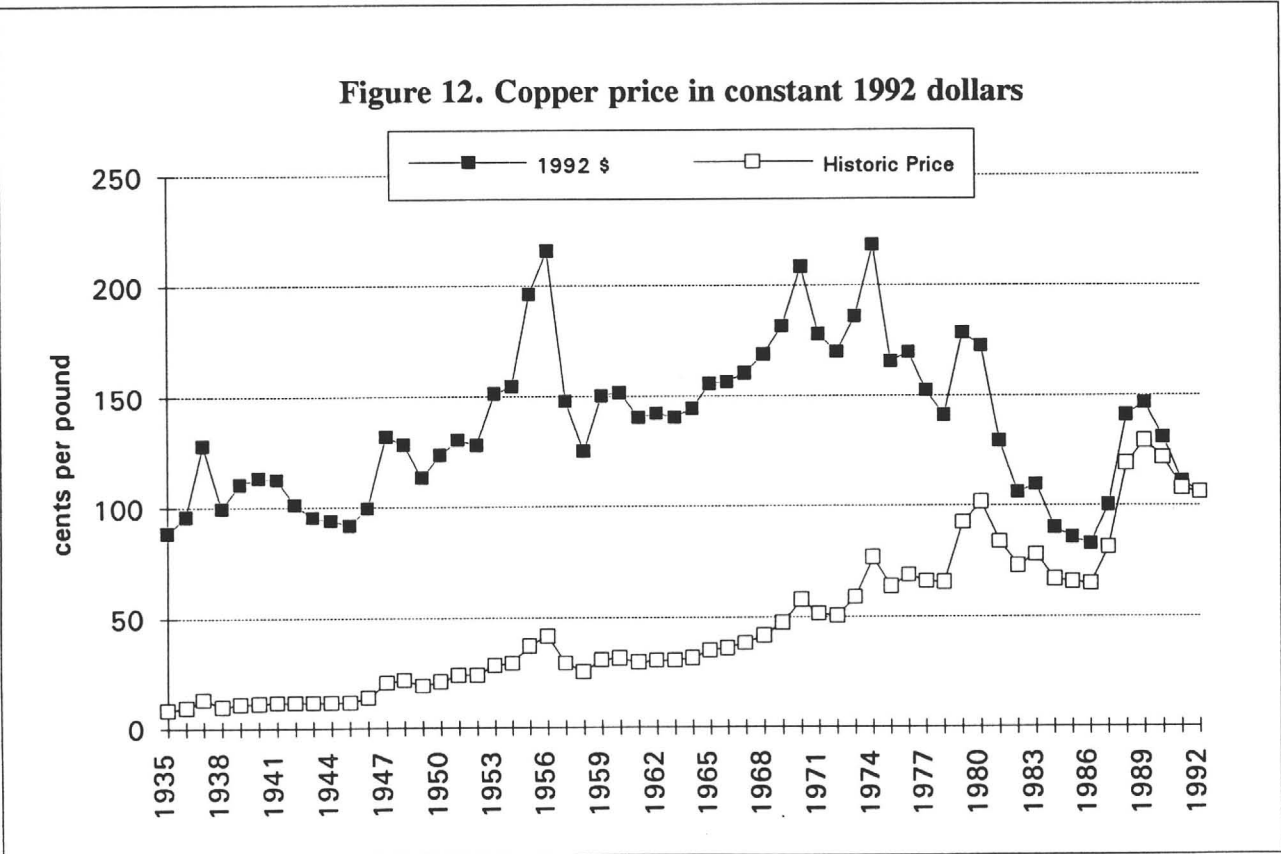
(2 Includes copper recovered by leaching in 1985 et.seq.

(3 Mill-leach costs after 1984 included in mill-float operating costs.

(4 Property, severance taxes, and royalties, if applicable.

(5 Includes all cash cost of production and credit for byproducts but excludes depreciation and profit. Costs are in actual dollars for each year shown.

Source: "Minerals Yearbook, Metals & Minerals," U.S. Bureau of Mines.



Source: "Non-ferrous Metal Data 1992," American Bureau of Metal Statistics. Inc.

economically disastrous 80's however, prompted an accelerated interest that continues today. Twelve plants operated during 1992 and 2 new leach only operations are in the planning and permitting stage. Production from the cementation process occurred at only 3 properties and has fallen to less than 2 percent of leach production.

CONCENTRATION

The majority of copper mineralization in Arizona is of the sulfide type and is generally not economically amenable to leaching. Inspiration had success with its heap leach-ferric cure process on mixed oxide-sulfide ores and Kennecott pioneered the use of bacteria to convert sulfides to oxides in low-grade dumps. However, as shown in the Operations Summary, about 69.5 percent of the copper was produced by the flotation method of concentration. In addition much of the leached copper produced is from dumps of low grade mineralization that was stripped from open pit mines to provide access to sulfide ore. Another aspect of the flotation process that makes it viable at some properties is the recovery of molybdenum by selective flotation. Molybdenum provides a significant portion of the revenues from some properties. Also, most precious metals in the ore follow the copper through the flotation and smelting steps to the electrolytic refinery where they are recovered from the anode slimes.

There are currently 12 flotation concentrators in operation in Arizona. Asarco is operating 4 - 2 at Ray and 2 at Mission, Cyprus is operating 2 - Bagdad and Sierrita, Magma is operating 3 - San Manuel, Pinto Valley, and Superior, Oracle Ridge is operating 1, and Phelps Dodge 2 at Morenci.

Although efficiency is constantly being improved, the flotation process is not cheap. It requires crushing and grinding the ore, separation of the ore minerals from the gangue minerals in the flotation cells, smelting the concentrate, and refining the copper anodes from the smelter. The most significant recent advance in flotation is the improved recoveries resulting from the use of column flotation cells that have been installed in most concentrators.

SMELTING

Of the 7 smelters remaining in Arizona in 1992 only 3 operated - Asarco's Hayden, Cyprus' Miami, and Magma's San Manuel. The smelter at Hayden that Asarco acquired from Kennecott met all significant environmental constraints when last operated in 1982. Magma's smelter at Superior and Phelps Dodge's smelters at Ajo and Morenci will require extensive retrofitting before they can be operated. Phelps Dodge ships concentrates to its Hidalgo smelter at Playas, New Mexico and to the Chino smelter at Hurley, New Mexico.

As an alternative to smelting, Cyprus Casa Grande operates the roast leach electrowinning (RLE) plant built by Hecla. In this process a portion of the flotation concentrates from Sierrita are roasted to make them acid soluble and then leached with sulfuric acid. Salable cathode copper is extracted from the leach solution by electrowinning. Cyprus upgrades the leach solutions in the solvent extraction plant before electrowinning. Acid produced from the roaster gases is used for leaching and the process is essentially pollution free.

Upgrading and expansion of the Miami smelter was completed in July with installation of Isasmelt technology developed by Mount Isa Mining Company in Australia. When operation reaches full capacity in 1993 Cyprus will be able to smelt all of their sulfide production.

HIGHLIGHTS OF COMPANY OPERATIONS

Note: Company addresses and phone numbers current as of November, 1993

ARIMETCO INCORPORATED

5099 E. Grant Rd, # 120 Tucson, AZ 85712
Phone (602) 795-5725

Arimetco operates the Emerald Isle and Johnson mines in Arizona. Combined production totaled nearly 9 million pounds from the 2 properties. The company is developing the Van Dyke and Zonia copper properties and also has industrial mineral interests in Arizona. At Van Dyke, which contains the company's largest copper reserve, shaft rehabilitation to allow access for in situ leach development was underway. Reserve confirmation drilling occurred at the recently acquired Zonia property.

Emerald Isle

Old Chloride Road, Chloride, AZ 86431
Phone (602) 565-4554

The Emerald Isle Mine, which consists of an open pit mine, heap leach, and an 8,000 pound-per-day SX-EW facility, began production in July, 1992. This small project is expected to operate for 3 years.

Johnson

Johnson Mine Road, Dragoon, AZ 85609
Phone (602) 586-2241

The Johnson Mine contributed over 45 percent of the company's production during 1992 by producing over 8 million pounds of copper. This was the first full year of mining by Arimetco at Johnson and included a 4 month period during which only waste stripping occurred as part of a pushback of the Burro pit.

Exploration drilling has extended the life of the Burro pit by confirming reserves of 4 million tons with additional potential remaining. The adjacent but undeveloped Copper Chief ore body contains 12 million tons grading 0.23 percent recoverable copper.

ASARCO INCORPORATED

Copper Division: 1150 N. 7th Ave., Tucson, AZ 85705, P. O. Box 5747, Tucson AZ 85703,
Phone (602) 798-7500

Asarco's Arizona operations consist of the Hayden copper smelter, 2 major open-pit mines, Mission and Ray, and a dump leaching/cementation facility at Silver Bell. The mines' production was 544 million pounds of copper in 1992. With the completion of expansion projects at Mission and Ray, Asarco has become self

sufficient in supplying copper concentrates to feed its smelters.

Joint venture partners Asarco and Freeport-McMoran continued the in situ leach research project at the Santa Cruz property in cooperation with the U.S. Bureau of Mines. Hydrologic data provided by the successful injection and recovery of saline solutions is being used to obtain an aquifer protection permit for the next phase of the project. That phase will finally test copper recovery by operation of a pilot-scale well field and surface recovery plant.

Asarco holds major copper reserves at Chilito north of Hayden, at the Copper Butte and Buckeye deposits west of Ray, at Helvetia east of Mission, and at Sacaton East near Casa Grande.

Hayden Smelter

Box 8, Hayden, AZ 85235
Phone (602) 356-7811

The Hayden smelter consists of an INCO flash furnace smelter rated at 720,000 tons of charge per year for an estimated production of 175,000 tons of blister copper. An acid plant rated at 1,600 tons of sulfuric acid per day keeps sulfur dioxide emissions within air quality limits. The smelter achieved a second consecutive year of record production.

Mission

Box 111, Sahuarita, AZ 85629
Phone (602) 648-2500

Mission consists of the consolidation of the Mission, Eisenhower, San Xavier, and Pima open-pit mines into one large pit referred to as the Mission complex. Also included is the small, separate San Xavier North pit. The acquisition of the rest of the Eisenhower in April of 1991 and of the Mineral Hill deposit adjacent to the Pima section of the pit late in 1987 increased reserves and facilitated further efficiencies in pit design and mine planning.

Mining at Mission is conducted by electric shovels with truck haulage to the primary crusher and waste dumps. Some areas of the pit are back to final limits, allowing some waste dumping in the pit. The stripping ratio in 1992 was 2.53, waste to ore; a high ratio that reflects removal of large amounts of waste related to expansion.

The expansion of the Mission Mine was completed in the fourth quarter of 1991, more than doubling production capacity from mid-1980's levels, to 124,000 tons of

Table 20. Average monthly price of cathode copper

[Prices are Metals Week U.S. producer delivered cents/lb. through July 1992.
Beginning August 1992 prices are U.S. producer cathode cents/lb.]

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
January	80.219	68.792	64.487	69.881	64.986	132.496	152.770	108.644	114.614	100.723
February	84.024	70.748	66.446	68.253	65.525	105.025	140.211	111.260	115.012	105.028
March	82.072	75.311	65.547	70.144	68.071	109.720	148.492	128.414	113.953	106.183
April	83.493	77.388	70.318	68.801	67.129	103.641	143.486	126.936	113.127	104.738
May	85.634	72.229	69.864	67.082	70.985	104.373	127.146	124.574	105.574	104.925
June	81.836	69.849	67.094	67.471	74.346	114.275	115.901	117.346	103.877	109.102
July	82.947	64.402	66.773	63.815	80.419	104.848	113.487	126.115	104.344	118.650
August	80.542	64.535	66.284	62.374	82.183	101.451	127.430	134.960	105.969	117.140
September	77.587	63.408	65.716	64.844	85.607	116.120	138.439	134.215	111.109	112.495
October	73.392	62.039	66.680	63.464	88.253	138.048	131.659	130.182	111.336	105.154
November	69.581	65.650	66.294	62.855	108.528	152.320	118.109	119.762	110.034	101.390
December	70.805	63.538	68.025	63.630	133.339	161.270	109.216	115.611	102.972	103.544
Annual average.	79.344	68.157	66.961	66.051	82.448	120.299	130.529	123.168	109.327	107.423

Source: Metals Week.

Figure 11. Average annual copper prices

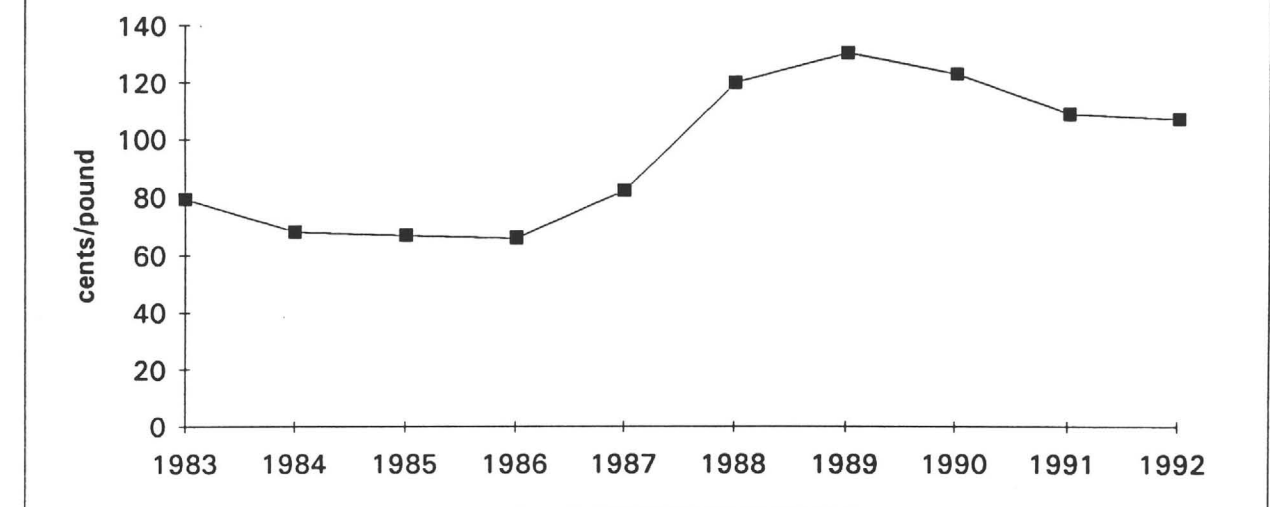
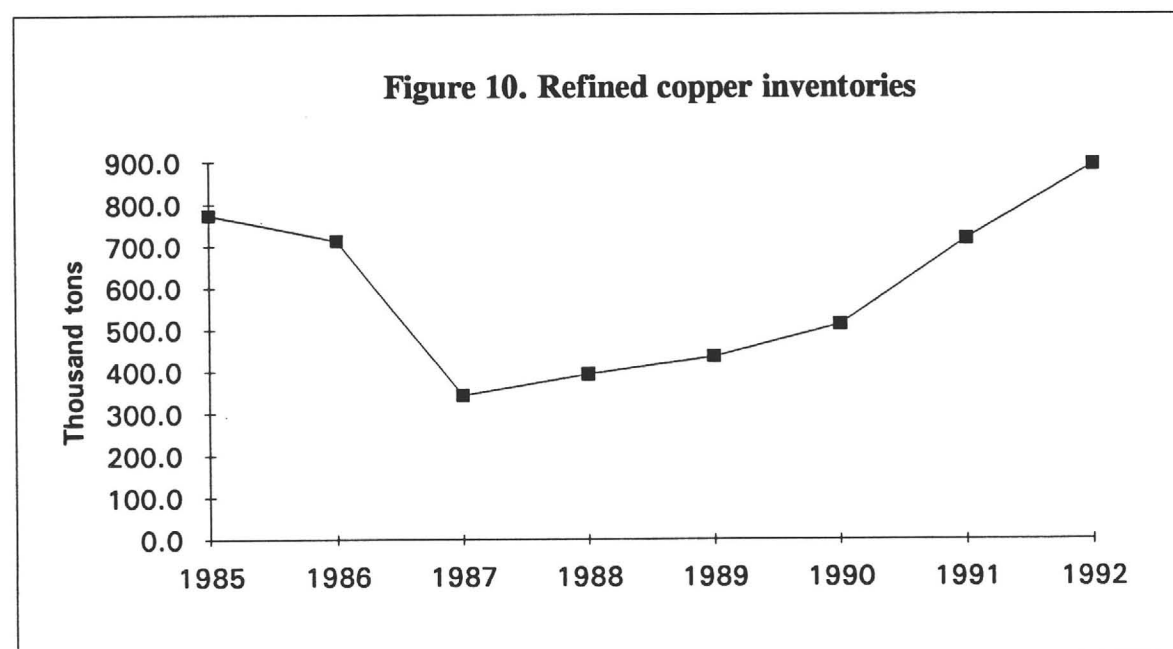


Table 19. Refined copper inventories

[Figures are end of year in thousand short tons]

Location	1985	1986	1987	1988	1989	1990	1991	1992
U.S. refineries	150.4	145.1	63.1	42.9	56.4	52.1	41.6	29.5
Comex warehouses	120.3	93.3	18.3	13.4	16.3	20.2	33.7	105.9
Total U.S.	270.7	238.4	81.4	56.3	72.7	72.3	75.3	135.4
Refineries elsewhere	293.7	280.6	202.6	265.0	243.3	239.4	274.1	409.0
LME warehouses	209.1	193.1	58.3	72.5	119.0	200.1	366.3	348.1
Total elsewhere	502.8	473.7	260.9	337.5	362.3	439.5	640.4	757.1
Aggregate Inventories	773.5	712.1	342.3	393.8	435.0	511.8	715.7	892.5

Source: "Non-ferrous Metal Data 1992," American Bureau of Metal Statistics Inc.



contained copper per year. The addition of the refurbished Pima mill, now called the South mill, increased concentrator capacity to a total of 59,000 tons per day.

Ray

P.O. Box 8, Hayden, AZ 85235

Phone (602) 356-7811

The Ray operation consists of an open-pit mine, dump leach and heap leach operations with a 40,000 ton-per-year SX-EW plant at Ray, a 31,000 ton-per-day concentrator at Hayden, and the new 30,000 ton-per-day concentrator at Ray.

Concentrate production increased over 60 percent with the start-up of the new Ray mill and made the Ray Mine the second largest producer in 1992. The new mill also allowed lowering of the cut-off grade to 0.3 percent copper. This allowed reserves to increase by almost 100 percent to 1.1 billion tons. This puts Ray among an elite group of 3 deposits in the U.S. with reserves in excess of 1 billion tons.

Mining is conducted by electric shovels supplemented by front-end loaders utilizing truck haulage. A 60,000 ton-per-day portable in-pit crusher and conveying system has replaced the 30,000 ton-per-day primary crusher at the pit. The stripping ratio in 1992 was 2.4:1, waste to ore, a high ratio that reflects mine development ahead of increased production.

Sulfide ore is hauled by truck to the crusher at Ray where it is crushed and transferred to trains for the 20-mile haul to the Hayden mill and is taken by conveyor to the stockpile for the Ray mill. Silicate ore is hauled and crushed, then further reduced to minus 3/4 inch by secondary and tertiary crushers. It is then transported by conveyor where it is agglomerated with sulfuric acid while in transit to the heap leach area. Final haulage and placement on the heaps is by end-dump trucks. Low grade material is hauled to prepared dump leaching areas and non-mineral muck is hauled to waste dumps by end dump trucks.

Silver Bell

25,000 W. Avra Valley Rd.

Marana, AZ 85653

Phone (602) 682-2420

Silver Bell consists of an open-pit copper mine and flotation mill, both presently on stand-by status, while dump leaching and operation of the precipitation plant have continued. Mining was stopped in 1984 due to high operating costs. Asarco plans to build a SX/EW plant that when completed would produce 18,000 tons of refined cathode copper per year at substantially lower cost. In late 1991 the company began the permitting process for construction of the SX-EW plant. Oxide ore is expected

to come from a new area of the property known as Silver Bell North.

CYPRUS COPPER COMPANY

Corporate Headquarters - 1501 W. Fountainhead Parkway, Tempe, AZ 85282

Phone (602) 929-4400

Cyprus was Arizona's second largest producer of copper in 1992 and continues to be the largest producer of molybdenum. Totals for the year were 647 million pounds of copper and 25 million pounds of molybdenum.

Cyprus Copper Company, a subsidiary of Cyprus Minerals Company, maintains its corporate headquarters in Arizona and operates 5 copper-producing mine complexes in the State: Bagdad, Casa Grande, Miami, Mineral Park, and Sierrita. In addition to its copper-molybdenum properties, Cyprus operates Arizona's largest gold mine, Copperstone, located north of Quartzsite. Quartzsite is in its last year of production.

In March, 1988, through a 15-year lease, Cyprus acquired the Twin Buttes property formerly operated by Anamax. In July, 1988 they acquired the entire Inspiration operation at Miami including the mines, concentrator (inactive), SX-EW plant, smelter, acid plant, electrolytic refinery, and rod plant.

Cyprus installed and operated the second copper SX-EW unit in the world at Bagdad and produced the first cathodes to meet the stringent specifications for trading on the London Metal Exchange and COMEX. The company currently produces 210 million pounds, or approximately 33 percent of their normal annual copper production, from SX-EW technology.

Bagdad

P.O. Box 245, Bagdad, AZ 86321

Phone (602) 633-2241

The Bagdad operation consists of an open-pit copper-molybdenum mine, a 75,000 ton-per-day concentrator, an oxide and low-grade sulfide dump leach operation, and an SX-EW plant. A project to increase mill capacity by 10 percent is underway and a major expansion is being considered.

Mining is conducted by electric shovels using truck haulage to the primary crusher and dumps. The stripping ratio in 1992 was 0.80:1, waste to ore. The sulfide ore is transported from the primary crusher at the mine, a distance of 6,400 feet, to the coarse ore stockpile at the concentrator by conveyor. There it is crushed further, ground by autogenous and ball mills, and then copper and molybdenum concentrates are produced. Column cells are utilized in the molybdenum flotation circuit.

Casa Grande

P.O. Box 15009, Casa Grande, Arizona 85230 5009

Phone (602) 623-1539

Casa Grande consists of an in situ leaching operation, a small heap leach, an SX- EW plant, and a RLE plant that treats concentrates from other Cyprus properties. The potential for open pit mining and heap leaching a portion of the deposit is being evaluated.

Block-caved stopes in the oxide ore body are being leached and development of a leaching operation in virgin ground is underway using high pressure pumps to inject sulfuric acid solution into holes drilled from the old underground workings. Pregnant solutions are collected in sumps underground and pumped to the SX-EW plant.

The roasters and acid plant of the RLE plant are treating approximately 150,000 tons per year of copper concentrates from other Cyprus operations. The pregnant solutions go to the SX-EW plant and the acid produced from the roaster gases is used for the leaching operations.

Miami

P.O. Box 4444, Claypool, AZ 85532

Phone (602) 473-7150

The Miami property consists of 3 open pit copper mines formerly called Bluebird, Inspiration, and Ox Hide, an SX- EW plant, a 24,000 ton-per-day concentrator that is currently on standby status, a smelter, an acid plant, an electrolytic refinery, and a 135,000 ton-per-year rod plant.

Ore is mined at the rate of 75,000 tons per day with electric shovels and hauled by truck to high grade, low grade, and waste dumps. The stripping ratio in 1992 was 0.83:1, waste to ore. Cathodes from both the electrowinning and electro refining sections are fed to the continuous-cast rod plant to produce 5/16 inch copper rod on reels holding three and one-third miles of rod each.

A 3-year pilot project with Arizona Ranch Management has been underway to test and evaluate the use of cattle as a tool to promote vegetative growth, to control dust, and curtail erosion on tailings at the Miami operation. Costs of reclamation were substantially reduced by the use of livestock in a reclamation process. Cattle are used on bare tailing material to prepare a base to stabilize the tailings and to promote plant growth.

A project to make Cyprus independent of outside smelting was completed in 1992. An increase in capacity from 450,000 tons to 650,000 tons of concentrate per year was completed in July, 1992 at the Miami smelter. The \$106-million project increased smelting capacity by about 50 percent. The new ISASMELT furnace began operation with production planned to gradually increase

until full annual capacity of 650,000 tons is reached in 1993.

Mineral Park

HC 37, Box 500, Kingman, AZ 86401

Phone (602) 565-2226

Mineral Park consists of an open-pit copper-molybdenum mine, a 15,000 ton-per-day concentrator, and a precipitation plant. Mine and mill are both on stand-by status. Production comes from conducting dump and in pit leaching with recovery via the precipitation plant.

Sierrita/Twin Buttes

P.O. Box 527, Green Valley, AZ 85622 Phone (602) 648-8500

Cyprus operates the Sierrita and Twin Buttes mines as one unit. The Sierrita property consists of an open-pit copper-molybdenum mine, a 95,000 ton-per-day concentrator, a ferromolybdenum plant with two molybdenum rasters, a rhenium plant, a dump leaching operation, and an SX-EW plant. Mining is conducted using electric shovels and truck haulage to the crushers and dumps. The stripping ratio in 1992 was 0.92:1, waste to ore.

More than three quarters of Cyprus' molybdenum concentrate from the Thompson Creek (Idaho), Bagdad, and Sierrita operations is processed at Sierrita's roasters to produce molybdenum oxide and ferromolybdenum that are shipped to customers worldwide.

The Twin Buttes property consists of an open pit mine, 6.8 mile conveyor, agitation leach vats, and a SX-EW plant. Production was restarted at the Twin Buttes Mine in 1988 using the conveyor to provide additional sulfide feed to the Sierrita mill. The stripping ratio in 1992 was reduced significantly to .73:1. Twin Buttes contributed over 40 percent of the copper produced at the Sierrita concentrator in 1992. The SX-EW plant at Twin Buttes is fed with solutions from agitation leaching of oxide ore.

MAGMA COPPER COMPANY

Corporate Headquarters - 7400 N. Oracle Road, Tucson, AZ 85704

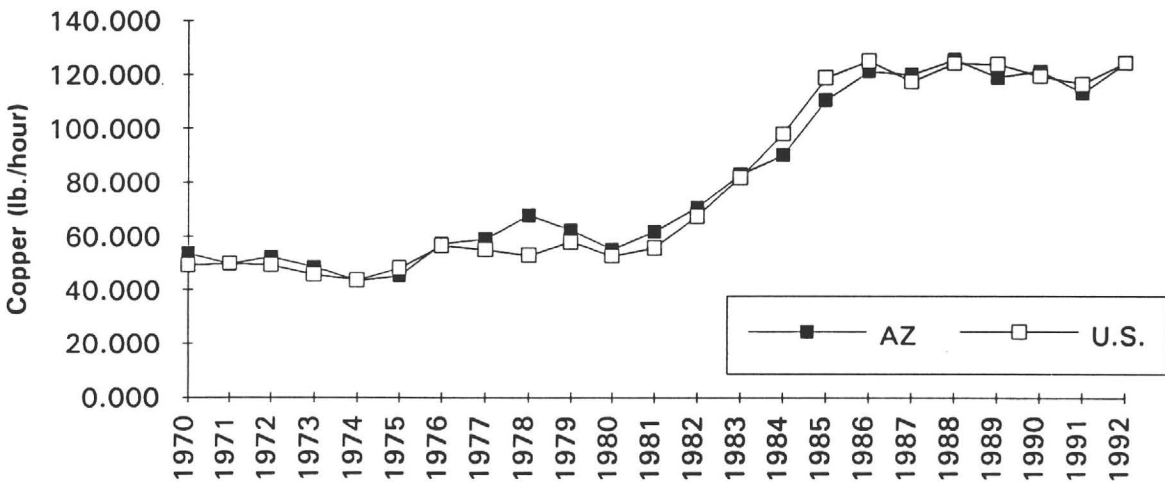
Phone (602) 575-5600

Magma's Arizona operations include the San Manuel, Pinto Valley, Miami, and Superior mines and a railroad. The railroad operation consists of 2 segments, a 29-mile line from San Manuel, and a 28-mile line from Superior, that both connect to the Santa Fe Southern Pacific system. The company also produced 19,000 ounces of gold from the McCabe, a small underground mine located near Prescott.

Table 18. Employment, earnings, and hours in copper mining in the United States and Arizona — continued

Year	Worker productivity					
	Recovered grade (lb. Cu/ton ore)		Ore mined/hour (tons)		Copper produced/hour (lb.)	
	AZ	U.S.	AZ	U.S.	AZ	U.S.
1970	12.16	13.07	4.427	3.759	53.829	49.132
1971	10.94	12.31	4.544	4.059	49.725	49.996
1972	10.95	12.23	4.761	4.017	52.161	49.151
1973	10.64	11.68	4.872	3.912	48.530	45.683
1974	9.57	10.72	4.547	4.062	43.496	43.539
1975	9.60	10.54	4.694	4.543	45.076	47.885
1976	10.53	11.16	5.410	5.040	56.968	56.250
1977	10.94	11.40	5.379	4.815	58.824	54.905
1978	11.03	11.21	6.131	4.713	67.607	52.817
1979	10.22	10.79	6.061	5.369	61.971	57.759
1980	9.84	10.49	5.588	5.004	54.994	52.465
1981	10.58	10.96	5.815	5.072	61.549	55.582
1982	11.62	12.50	6.064	5.388	70.442	67.342
1983	9.91	11.66	8.356	7.005	82.766	81.707
1984	10.90	12.70	8.250	7.703	89.921	97.795
1985	10.21	10.21	10.790	11.606	110.141	118.470
1986	10.44	12.69	11.576	9.847	120.897	124.934
1987	10.38	12.80	11.545	9.155	119.827	117.189
1988	10.76	12.86	11.658	9.637	125.398	123.918
1989	10.22	12.63	11.620	9.805	118.739	123.828
1990	10.20	12.65	11.874	9.430	121.133	119.245
1991	8.76	11.78	12.905	9.880	113.016	116.400
1992	8.73	11.92	15.935	10.430	123.910	124.290

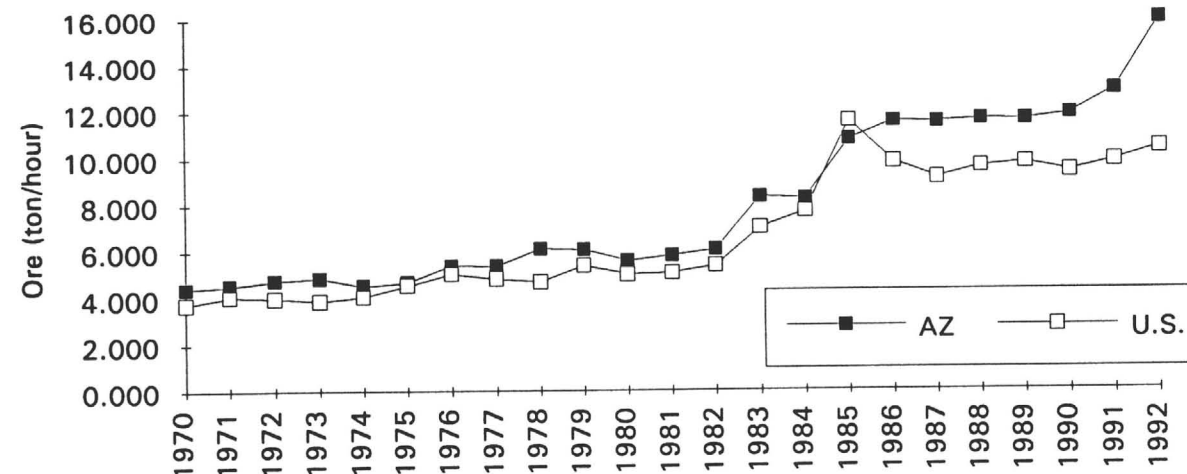
Figure 9. Worker productivity - copper



**Table 18. Employment, earnings, and hours in copper mining
in the United States and Arizona — continued**

Year	Production workers							
	Annual earnings (6		Aggregate hours (7		Copper ore mined		Copper produced	
	AZ	U.S.	AZ	U.S.	AZ	U.S.	AZ	U.S.
			(thousands)		(thousand short tons		(recoverable content,	
							thousand pounds)	
1970	8,997	9,135	33,936	68,570	150,241	257,729	1,826,734	3,368,957
1971	9,282	9,280	32,852	59,785	149,294	242,656	1,633,568	2,986,599
1972	10,124	9,994	34,827	66,410	165,815	266,831	1,816,118	3,264,113
1973	10,751	10,734	38,072	74,127	173,605	289,998	1,847,635	3,386,357
1974	11,552	11,776	39,331	72,237	178,821	293,443	1,710,744	3,145,148
1975	12,866	12,903	35,929	57,891	168,656	263,003	1,619,535	2,772,111
1976	14,888	14,596	35,865	56,300	194,046	283,736	2,043,168	3,166,889
1977	15,755	15,014	31,347	53,994	168,601	259,974	1,843,949	2,964,539
1978	17,928	17,597	29,066	55,952	178,201	263,722	1,965,072	2,955,210
1979	21,050	21,061	33,654	54,366	203,977	291,078	2,085,556	3,140,110
1980	23,202	22,621	30,358	48,183	169,650	241,090	1,669,495	2,527,920
1981	25,859	25,612	37,278	60,353	216,787	306,089	2,294,437	3,354,548
1982	25,771	25,215	24,098	37,229	146,125	200,589	1,697,500	2,507,070
1983	27,001	27,180	18,299	28,010	152,902	196,203	1,514,538	2,288,612
1984	28,799	29,002	17,610	24,601	145,278	189,499	1,583,505	2,405,866
1985	29,838	29,888	16,146	20,627	174,218	239,399	1,778,334	2,443,675
1986	30,284	26,415	14,496	18,899	167,808	186,105	1,752,525	2,361,127
1987	28,946	25,595	14,388	23,981	166,113	219,545	1,724,068	2,810,182
1988	26,932	26,526	15,033	25,567	175,261	246,380	1,885,112	3,168,229
1989	29,186	28,103	16,926	26,674	196,684	261,534	2,009,782	3,303,002
1990	31,177	29,593	17,952	29,166	213,168	275,024	2,174,574	3,477,904
1991	33,731	31,749	20,042	30,893	258,647	305,221	2,265,072	3,595,930
1992	33,987	32,075	18,280	31,309	291,295	326,539	2,542,932	3,891,404

Figure 8. Worker productivity - ore mined



Poston Butte, a major copper deposit, was acquired from Conoco. Located near Florence, it contains 300 million tons of oxide and 500 million tons of sulfide copper mineralization.

An innovative 15-year labor contract was signed in October, 1991. The contract is tailored to the needs of all parties, the company, unions, employees, and management, and is dedicated to employee involvement, raising productivity, lowering production costs, and increasing job security. Strikes and lockouts are prohibited for a 7-year period. Gain sharing plans, by division, allow employees to share the rewards of improved productivity, cost reductions, and better safety performance.

San Manuel

**P.O. Box M, San Manuel, AZ 85631
Phone (602) 385-3100**

San Manuel consists of an underground copper-molybdenum mine, a 62,000 ton-per-day concentrator, an open-pit oxide copper mine, a heap leach, an in situ leach, an SX-EW plant, a 1,000,000 ton-per-year smelter, a 3,000 ton-per-day acid plant, a 300,000 ton-per-year electrolytic refinery, and a 180,000 ton-per-year rod plant.

Mining at San Manuel uses the block-caving method. After development of the grizzly and haulage levels, caving is initiated by undercutting the ore block. The caved ore is drawn through the grizzlies to the haulage level. Haulage to the production shafts is by 23-ton trolley locomotives pulling ten 15-17 ton ASEA cars or fifteen 12-13 ton rotary dump cars. After hoisting to the surface the ore is hauled by rail about 8 miles to the mill in 100-ton cars in groups of 35 to 40 pulled by 125-ton diesel-electric locomotives. Utilization of production techniques developed in the Kalamazoo ore body pilot production project have lowered mining costs at the San Manuel underground ore body to under \$4.00 per ton. Nearly 20 million tons of ore were hoisted in 1992.

As the depletion of the San Manuel ore body's reserves in 1998 approaches, Magma has been conducting a feasibility study to assess the viability of mining the down faulted Kalamazoo ore body. In early 1993 Magma's board of directors approved the development of Kalamazoo. Development is estimated to cost \$135 million, but upon completion in 1997, it will extend the life of San Manuel's underground mine by 12 years to 2009.

Mining at the open-pit oxide mine is accomplished with front-end loaders with truck haulage at the rate of 28,000 tons of ore and 65,000 tons of waste per day. Ore is placed on the polyethylene-lined leach pads and some of the waste is dumped in the subsidence area. Any sulfide ore encountered is hauled to a railroad siding and

added to the feed going to the concentrator. Copper is recovered from the leach solutions at the SX-EW plant that uses the ISA process of plating the copper on stainless steel sheets rather than on copper starter sheets.

The solutions from the in situ leaching are also fed to this plant that has a capacity of 75,000 tons of copper per year. When the open pit oxide reserves are exhausted in 1994, in situ leaching will likely increase. Cathodes from the electrolytic refinery and the SX-EW plant are melted and cast into continuous rods at the rod plant.

The San Manuel smelter accounts for 25 percent of U.S. copper smelting capacity. The Outokumpu flash smelting furnace, with a design capacity of 3,000 tons of concentrate daily, is the largest single furnace smelter in the industry. During 1992 the smelter processed over 1 million tons of concentrate.

Increasing copper concentrate production, combined with very large capital costs for new smelter construction and the long time required to obtain the necessary environmental permits, have resulted in a "smelter bottleneck." To take advantage of this situation, in the spring of 1992, Magma announced plans to increase its smelter capacity by 20 percent. The company reports that more than one quarter of its copper throughput is derived from custom smelting and refining.

Pinto Valley/Miami

**P.O. Box 100, Miami, AZ 85631
Phone (602) 473-6200**

Magma's Pinto Valley Division consists of the Pinto Valley and Miami mines. At Pinto Valley mining is accomplished with electric shovels and truck haulage to the 63,000 ton-per-day concentrator. A dump leach with 9,000 tons-per-year SX-EW plant are also in operation. During 1992 nearly 23 million tons of ore were mined and over 162 million pounds of copper were recovered.

Pinto Valley's open pit mine is scheduled to close in 1999 following depletion of reserves. A study is underway to determine if the large, unmined resource remaining can be made economic. If successful, mine life could be extended 6 years.

The Miami operation consists of an in situ leach of rubble remaining in the mined-out Miami block-cave area and hydraulic mining/leach reprocessing of the Number 2 tailings. Leach solutions from both are processed at a 14,000 ton-per-year SX-EW plant. Miami's block cave area in situ leach produced nearly 12 million pounds of copper. This is one of the more impressive production performances in the state for a deposit with "no reserves."

In 1988, following favorable metallurgical testing, feasibility study, and permitting, the company began the project for the reclamation and leaching of mill tailings

associated with the old Miami underground mine. The tailings are reclaimed using hydraulic monitors to produce a slurry of tailings and water. Sulfuric acid is added to slurry to dissolve the contained copper and the resulting pregnant leach solution is processed through the Miami's SX-EW plant. The remaining tailings are thickened and transported for disposal through an overland pipe to an inactive Miami pit. During 1992 these decades old tailings yielded approximately 7.7 million pounds of copper. Production from this project is expected to continue until 1998.

Superior

P.O. Box 37, Superior, AZ 85273
Phone (602) 689-2444

Superior, also know as the company's namesake Magma mine, consists of an underground mine, a 3,300 ton per day flotation mill, and an inactive copper smelter. Concentrates are shipped by rail car to the San Manuel smelter for treatment. This deep, hot, high-grade mine reopened in 1990. During 1992 it produced over 24 million pounds of copper from only 238,407 tons of ore. This represents a recovered grade of over 5 percent copper, approximately 10 times the state average.

ORACLE RIDGE MINING PARTNERS

Oracle Ridge Mine

P.O. Box 7, San Manuel, AZ 85631
Phone (602) 576-1412

Oracle Ridge Mining Partners consists of 2 partners. South Atlantic Ventures Ltd. of Vancouver, British Columbia, the mine's operator has a 70 percent interest, while the remaining 30 percent is owned by Continental Materials of Chicago, Illinois.

The underground Oracle Ridge mine is located 15 miles north-northwest of Tucson on the east flank of the Santa Catalina Mountain. A new column flotation mill started operation on February 28, 1991. During 1992 the mine and mill produced nearly 7 million pounds of copper in concentrates that were shipped to Asarco's Hayden smelter.

PHELPS DODGE CORPORATION

Corporate Headquarters - 2600 North Central Avenue, Phoenix, AZ 85004- 3015
Phone (602) 234-8100

Phelps Dodge is the world's second largest and the United States' largest copper producer, accounting for about 33 percent of U.S. production from its mines in southeastern Arizona and southwestern New Mexico. Facilities in Arizona consist of 2 operating properties,

Morenci and Copper Queen, along with New Cornelia, a closed open-pit mine, mill, and smelter complex located at Ajo. In conjunction with its Arizona operations, it operates 2 mines, Tyrone and Chino, near Silver City, New Mexico, 2 smelters, Hidalgo and Chino, both in New Mexico, and a 420,000 ton-per-year refinery located at El Paso, Texas.

In 1992 Phelps Dodge's U.S. mines and facilities produced 621,600 tons of copper; 512,600 tons for the company and the balance for the accounts of minority interest owners. This production included a record 290,300 tons of copper from SX-EW plants making the company the largest SX-EW copper producer in the world. Copper produced by SX-EW accounted for 45 percent of Phelps Dodge's total production in 1992, compared with only 31 percent just 2 years ago. This amount is 50 percent higher than the Arizona industry average. SX-EW production, with its low unit costs, is a major factor in the company's successful effort of being a low cost copper producer.

In addition to the developed operations described above, Phelps Dodge conducted exploration on their significant holdings in the Safford district. Continued exploration drilling on the Dos Pobres deposit increased the estimate of leachable copper to 270 million tons with a grade of 0.46 percent copper and sulfide material to 230 million tons with a grade of 0.89 percent copper. The adjacent Lone Star deposit contains a leachable resource of 1,600 million tons with a grade of 0.38 percent copper.

Morenci

4521 State Highway 191, Morenci, AZ 85540
Phone (602) 865-4521

Phelps Dodge's Morenci Mine is the largest copper producing mine in North America and the second largest copper producer in the world. The operation consists of 3 open pits, 2 concentrators, and an SX-EW plant. Phelps Dodge owns an 85 percent interest in the Morenci Mine; the remaining 15 percent is owned by Sumitomo Metal Mining Company, Ltd. and Sumitomo Corporation. Morenci employs nearly 2,100 people. During 1992 Morenci produced a record 389,300 tons of copper, accounting for more than 60 percent of all copper produced by Phelps Dodge.

The operation consists of the combined Morenci-Metcalf-Northwest Extension open pit copper mines, the 60,000 ton-per-day Morenci concentrator with a molybdenum circuit, the 40,000 ton-per-day Metcalf concentrator, 3 SX plants, and an 170,000 ton-per-year EW tank house. The 650,000 ton-per-year smelter with a 2,400 ton-per-day acid plant remain inactive and will require extensive modifications to meet air quality restraints if ever reactivated.

Table 18. Employment, earnings, and hours in copper mining in the United States and Arizona

[These statistics do not reflect workers in copper smelting, refining, and rod fabrication]

Year	All employees		Production workers							
	Average number		Average number		Weekly earnings (4		Weekly hours		Hourly earnings (5	
	(thousands)		(thousands)		(average)		(average)		(average)	
	AZ (1	U.S. (2	AZ (3	U.S. (2	AZ	U.S.	AZ	U.S.	AZ	U.S.
1970	18.8	37.0	14.9	29.5	173.01	175.67	43.8	44.7	3.95	3.93
1971	18.9	34.7	14.9	26.8	178.50	178.46	42.4	42.9	4.21	4.16
1972	20.5	38.9	16.1	30.7	194.69	192.19	41.6	41.6	4.68	4.62
1973	21.5	42.3	17.6	33.7	206.75	206.42	41.6	42.3	4.97	4.88
1974	24.0	42.8	19.1	33.8	222.16	226.46	39.6	41.1	5.61	5.51
1975	22.5	37.1	17.9	28.4	247.43	247.14	38.6	39.2	6.41	6.33
1976	21.7	35.5	17.2	27.0	286.31	280.70	40.1	40.1	7.14	7.00
1977	19.3	35.1	15.3	26.9	302.99	288.73	39.4	38.6	7.69	7.48
1978	17.2	35.2	13.7	26.9	344.76	338.40	40.8	40.0	8.45	8.46
1979	19.3	31.9	15.3	24.6	404.81	405.03	42.3	42.5	9.57	9.53
1980	17.7	29.4	14.0	22.6	446.19	435.01	41.7	41.0	10.70	10.61
1981	21.9	36.2	17.4	27.9	497.28	492.54	41.2	41.6	12.07	11.84
1982	15.2	25.3	12.1	18.5	495.60	484.91	38.3	38.7	12.94	12.53
1983	11.3	18.9	9.0	13.5	519.25	522.69	39.1	39.9	13.28	13.10
1984	10.5	16.3	8.2	11.4	553.83	562.74	41.3	41.5	13.41	13.56
1985	9.4	13.1	7.5	9.4	573.80	574.76	41.4	42.2	13.86	13.62
1986	8.7	11.4	6.9	8.8	582.38	507.99	40.4	41.3	14.42	12.30
1987	8.6	13.5	6.9	10.7	556.65	492.20	40.1	43.1	13.88	11.42
1988	8.8	14.4	7.0	11.2	517.74	510.12	41.3	43.9	12.53	11.62
1989	9.5	14.1	7.5	11.2	561.26	540.44	43.4	45.8	12.94	11.80
1990	10.0	15.1	7.9	12.3	599.84	569.09	43.7	45.6	13.72	12.48
1991 (8	11.1	15.8	8.8	13.0	648.68	610.55	43.8	45.7	14.81	13.36
1992 (9	10.2	16.5	8.1	13.5	653.60	616.82	43.4	44.6	15.06	13.83

- (1) These figures are estimates made by the Arizona Department of Economic Security in cooperation with the U.S. Bureau of Labor Statistics. They include all full-time and part-time wage and salary workers who are employed in copper mining in any part of the pay period that included the 12th of each month of the year.
- (2) 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 (1) above, adjusted periodically to census bench mark.
- (3) Estimates of production (non-supervisory) workers based upon samplings as in (2) above. Since 1975 figures have been calculated by the Arizona Department of Mines and Mineral Resources dividing the annual number of "All Employees in 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. Last checked in 1992.
- (4) Weekly earnings figures are the product of hourly earnings and weekly hours for that year.
- (5) 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 hourly earnings.
- (6) Weekly earnings times 52 weeks.
- (7) Product of the number of production workers, weekly hours, and 52 weeks.
- (8) Arizona production worker's average number, aggregate hours and productivity figures for 1991 are revised.
- (9) Quantity of copper ore mined - U.S. in 1992 is an estimate.

Source: Table 1 this publication, American Bureau of Metal Statistics Unit, Arizona Department of Economic Security, Mineral Yearbook - Metals, Minerals," U.S. Bureau of Mines. "Employment and Earnings," U.S. Dept. of Labor, Bureau of Labor Statistics, March issues, U.S. Dept. of Interior.

Table 17. Arizona employment and wages in 1991, by industry

Industry	Employees (average number)	Total wages	Annual wage (average)	Weekly wage (average)
Copper mining	10,194	423,649,777	41,558.74	799.21
Copper smelting and refining	2,005	77,764,200	38,785.14	745.87
Copper rod fabrication	309	9,623,873	31,145.22	598.95
Total copper mining and processing	12,508	511,037,850	40,856.88	785.71
Other mining, quarrying and processing	2,477	88,545,413	35,747.04	687.44
All mining quarrying and processing	14,985	599,583,263	40,012.23	769.47
Manufacturing except copper processing	169,546	5,415,852,279	31,943.26	614.29
Construction	79,783	1,869,127,644	23,427.64	450.53
Transportation and utilities	73,822	2,185,176,649	29,600.62	569.24
Wholesale trade	76,779	2,277,401,616	29,661.78	570.42
Retail trade	300,395	4,078,541,172	13,577.26	261.10
Finance, insurance, and real estate	94,441	2,731,850,421	28,926.53	556.28
Services and miscellaneous	407,758	8,874,173,379	21,763.33	418.53
Agriculture, forestry, and fishing	35,862	481,431,862	13,424.57	258.16
Federal, state, and local government	276,455	6,926,091,993	25,053.23	481.79
Total and averages	1,529,826	35,439,230,278	23,165.53	445.49

(1) Includes all employees covered by Arizona employment security laws.

Source: Research Administration, Arizona Department of Economic Security.

Mining is conducted with electric shovels and truck haulage utilizing a computer controlled Modular Mining Truck Dispatching System for maximum efficiency. During 1989 the completion of the in-pit crushing and conveying system eliminated rail haulage completely. The trucks dump into 2 semi-mobile primary crushers in the pits and the crushed ore is conveyed to the coarse ore stockpile by conveyor belt. Each concentrator is fed by conveyors running under the stockpile. Both concentrators are standard flotation mills except that column flotation cells have been installed in the cleaner circuit of each.

All mined material other than sulfide ore is classified as leach material and is taken to one of several leach dumps. There are 3 widely-spaced solvent extraction plants to upgrade the solutions before they are pumped to the centrally located tank house for electrowinning.

Construction was completed in May 1992 on the \$112-million Northwest Extension project that added 70,000 tons of SX-EW production per year. With completion of this project the Morenci SX-EW facilities are the largest in the world, with an annual production capacity of 170,000 tons of high-purity cathode copper. Reentry into the Metcalf pit and extension/relocation of the ore crushing and conveying system was completed.

Evaluation of the feasibility and timing of expanding the mining operation north of Northwest Extension to the Coronado deposit continued. The Coronado deposit contains 180 million tons of sulfide material with a grade of 0.71 percent copper and 300 million tons of leachable material with a grade of 0.29 percent copper.

Morenci employees matched their all time safety record by working more than 3.3 million hours without a lost-time accident! Congratulations on a job done safely and well.

Copper Queen

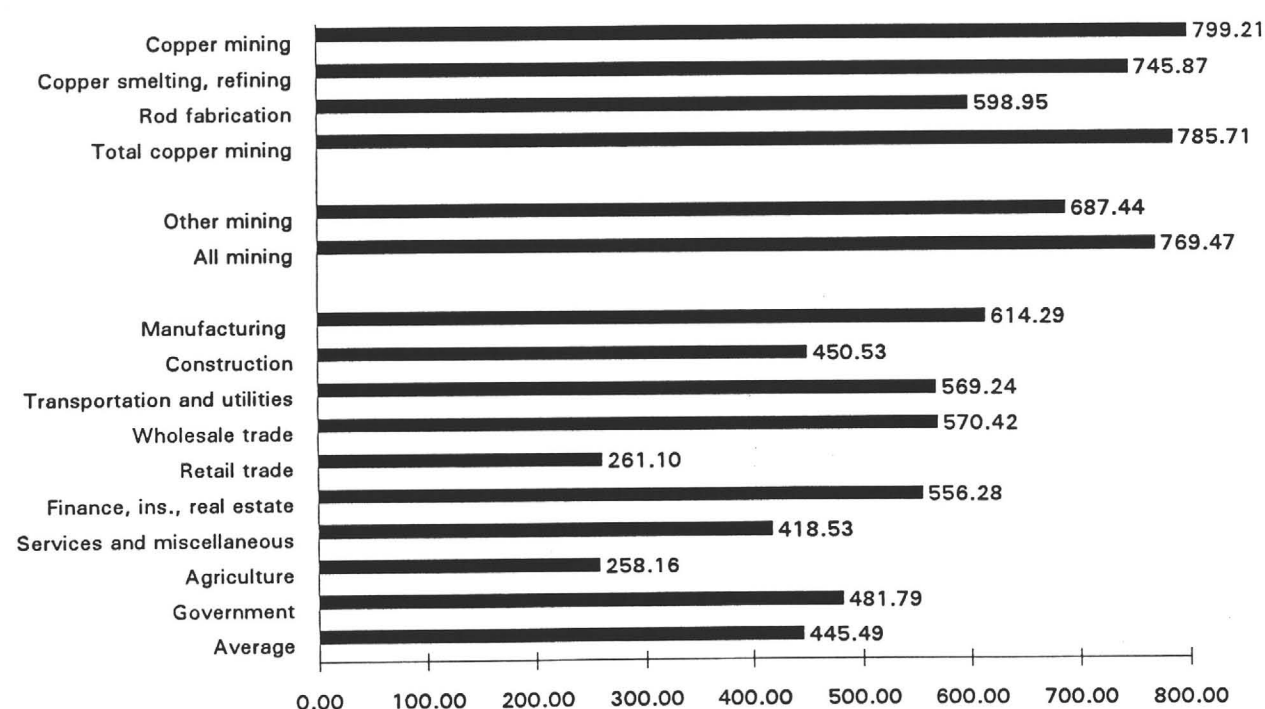
Highway 92, Bisbee, AZ 85603

Phone (602) 432-3621

The company's Copper Queen facility consists of a small dump leaching and precipitation operation at the mined-out Lavender pit. Production in 1992 was 2.4 million pounds of copper.

An additional leach copper resource is available at the adjacent 210-million-ton Cochise deposit. Metallurgical work has been done and indicates that, if brought into production, it could produce 80 million pounds of copper annually for over 10 years. Cochise is unlikely to be developed without construction of a new SX-EW facility and that decision would likely require improvement in the copper market.

Figure 7. Average weekly wages by industry



SEVERANCE TAX ON METALLIFEROUS MINERALS

The Severance Tax on metalliferous minerals is a tax on the production or extraction of metalliferous minerals from the earth, not on the sales of such minerals. A brief discussion of the tax is provided here; for more complete information contact the Arizona Department of Revenue, 1600 W. Monroe, Phoenix, Arizona 85007, phone (602) 255-3381. Citations used below are from the Arizona Revised Statutes.

Tax Base

The severance tax is levied on the "net severance base" of all metalliferous minerals produced after 1982 (42-1462). The "net severance base" is the greater of the following 2 values (42-1464, Laws of 1982, Chapter 230, Section 12):

1. The "weighted mineral value", or
2. A specified percentage of the old sales tax base (the gross value of production less out-of-state processing costs). This value will be referred to as the "Arizona value" after June 30, 1985.

The "weighted mineral value" is essentially the cost of extracting the minerals from the earth and delivering them to the site where they will be processed.

The "weighted mineral value" is determined as follows (42-1464):

1. Divide the mining costs by the production costs.
2. Multiply the quotient computed in (1) above by the gross value of production.

Definitions:

mining costs: represent the cost of extracting the minerals from the earth and delivering them to the site where they will be processed further (42-1461)

total production costs: include most of the major costs incurred in mining and processing minerals until the point of sale (42-1461).

gross value of production: is determined by multiplying the recoverable units of a metallic product by the price per unit of the product; the price per unit does not include the cost of manufacturing, fabricating or otherwise transforming a refined mineral product, when these activities occur prior to sale of the product (42-1461).

Although metalliferous minerals will no longer be taxed on the old sales tax base, the value of minerals produced after 1982 may not fall below a specified percentage of the old tax value (42-1464, Laws of 1982, Chapter 230, Section 12). The old tax value included not only the cost of extracting the minerals from the earth, but most of the major in-state costs of producing the minerals. This value was determined by multiplying

the recoverable units of a metallic product by the price per unit and deducting the out-of-state processing costs from the result (42-1464; Laws of 1982, Chapter 230, Section 12; 41-1461).

Tax Rate

2.5% of the net severance base.

Purpose

To aid in defraying the necessary and ordinary expenses of the state, cities, and counties to reduce or eliminate the annual tax levy on property for state, city and county purposes and to reduce the levy on property for public school education (Laws of 1982, Chapter 230, Section 17).

Eighty percent of the collected taxes are distributed in the same manner as the transaction tax (i.e. 25 percent to the cities, 33.6 percent to the counties, and 41.4 percent to the State). The remaining 20 percent of the collected taxes are deposited each year in the State's general fund and are appropriated for public education purposes (42-1465; Laws of 1982, Chapter 230, Section 16).

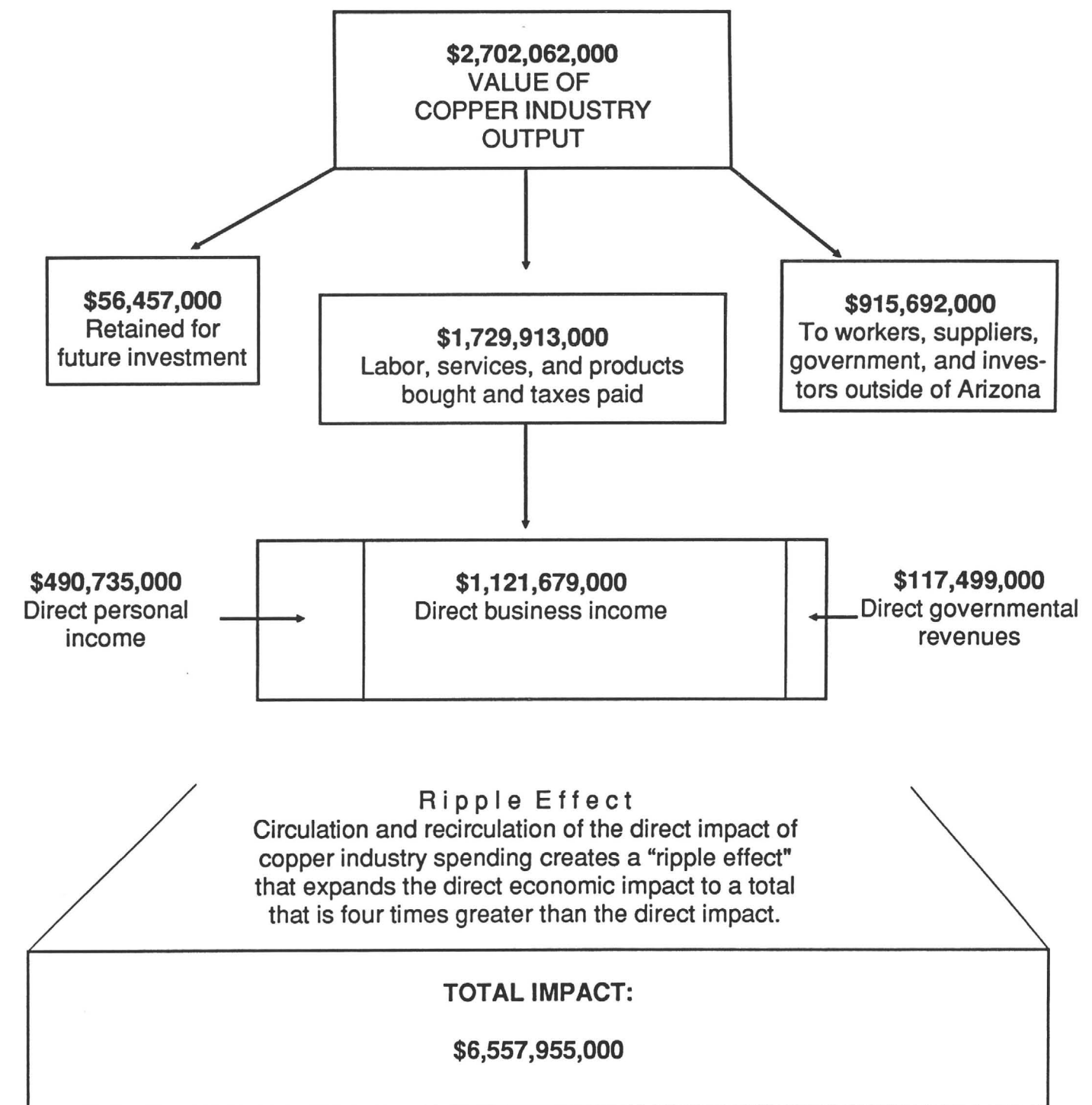
Source: *State of Arizona Tax Handbook - 1992*
Joint Legislative Budget Committee.

Severance tax paid to the State of Arizona on metalliferous minerals*

Fiscal Year	Net Collections
1991-92	\$27,926,566
1990-91	30,103,041
1989-90	29,552,883
1988-89	30,906,899
1987-88	19,268,473
1986-87	11,979,174
1985-86	13,990,039
1984-85	10,101,077
1983-84	9,814,062
1982-83	4,045,392

Source: Arizona Department of Revenue, Annual Reports.

Figure 6. Direct and indirect impact of the copper industry on the Arizona economy - 1992



Source: Leaming, G.F., 1992, "The Copper Industry's Impact on the Arizona Economy"

Table 16. Employment and wages in Arizona copper mining and smelting

Year	Employees (1 (average number)	Total wages	Annual wage (average)	Weekly wage (average)	Copper ore mined (tons)
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	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
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
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
1979	23,239	494,963,476	21,299	409.60	203,997,408
1980	21,602	510,168,454	23,617	454.17	169,650,401
1981	26,031	687,434,789	26,408	507.85	216,787,430
1982	17,182	487,415,292	28,368	545.53	135,768,647
1983	13,864	395,266,852	28,510	548.29	135,301,652
1984	12,556	387,028,537	30,824	592.77	145,278,431
1985	11,155	349,311,047	31,314	602.19	174,218,218
1986	10,848	326,915,975	30,136	579.54	167,808,000
1987	10,340	299,297,407	28,946	556.65	166,113,000
1988	10,588	348,502,604	33,008	634.78	175,261,000
1989	11,111	383,199,684	34,488	663.23	196,684,000
1990	11,352	411,433,093	36,243	696.99	213,168,000
1991	12,369	462,827,195	37,418	719.58	258,646,597
1992	12,508	511,037,850	40,012	785.71	291,295,132

1) Reported as "Covered Employment" that by law includes all employees of employers of three or more persons. Prior to 1966 only a portion of the workers in smelting, refining, and rod fabrication were included in this table.

Source: Table 17, this publication; "Minerals Yearbook - Area Reports: Domestic," U.S. Bureau of Mines; Research and Statistics Unit, Arizona Department of Economic Security.

PROPERTY TAX

The following has been excerpted from *Appraisal Manual for Mines and Natural Resources* by Donald E. Ross of the Arizona Department of Revenue which was effective as of January 1, 1988 and is revised annually.

The Natural Resource Unit of the Division of Property Valuation and Equalization is assigned the responsibility of valuing producing and nonproducing mines and oil, gas, and geothermal interests. Arizona Department of Revenue mine valuation regulations R15-4-201 through R15-4-206 are incorporated into this manual.

Arizona Revised Statutes (ARS Section 42-201.8) states:

"Producing mine or mining claim" means any mine or mining claim from which any coal, mineral or mineral substance, other than clay, sand, gravel, building stone or any mineral substance normally processed into artificial stone, has been extracted for commercial purposes at any time during a period of one year prior to the first Monday in January of the tax year."

A producing mine includes the land utilized for mining purposes together with structures and facilities necessary to sustain mining operations. It also includes equipment used directly in the process of extracting ores or minerals from the earth for commercial purposes, including equipment required to prepare the materials for extraction and the handling, loading or transportation of such extracted material to the surface. Mining includes underground, surface and open-pit operations for the extraction of ores and minerals.

If mining operations cease, real and personal property associated with a mining operation will continue to be valued by Centrally Valued Properties for a period of three years. The nonoperating mine will be retained in the legal class 1 for the first year after mining operations are terminated. The legal class designation used for the next two years will depend on the use of the property, which could be class 4 if the property remains idle.

Three years after mining operations have ceased, the valuation of the nonproducing mining property will be transferred from the Centrally Valued Properties' jurisdiction to the Locally Valued Properties' jurisdiction. From this point on, the county assessor is responsible for classifying and valuing the subject property. Such property will be classified according to its current use. If the real and/or personal property is idle at the expiration of the three-year period, it normally will be classified legal Class Four property.

The Natural Resource Unit of the Centrally Valued Properties Section of the Arizona Department of Revenue is responsible for determining annually the value of all producing mines as of the first day of

January of the tax year. Property within the context of a producing mine excludes manufacturing operations such as a rod plant. In summary, the value of taxable producing mine property for Arizona property tax purposes includes land, supplies inventories, ore reserves, construction work in progress, personal property and improvements.

Summary of Procedures

Producing mines are taxed on the basis of their assessed value multiplied by the local tax rate which produces the tax due. The assessment ratio for 1988 is 28% of the full cash value or market value. The full cash value is determined by the mineral property appraiser after correlating the three approaches to value, namely the income, cost and market approaches.

The income approach consists of discounting two different future income streams as developed by (1) the mining company and (2) by the Department utilizing a single rate factor. The Department has developed a method in which a five-year history, expressed as a profit margin, is combined with the future production schedule to produce a future income stream. The historical data are expressed on a production basis, not on a sales basis. This five-year margin method avoids the problems of predicting the future price of copper and other metals. It is supported in the literature and has been approved by the Arizona Supreme Court. The past is only a valid indicator of the performance level of a relatively stable operation and should not be used for new or dying mines. The historical data are averaged to flatten the effects of the peaks and it is generally accepted as standard for financial reporting, and the Securities and Exchange Commission reports.

Cost approach values are determined by computing the reproduction cost new less depreciation for the physical assets. Straight line depreciation is utilized along with appreciation or inflation factors as developed by the Department. Economic and functional obsolescence can be allowed for by the appraiser if warranted.

Comprehensive field notes are written for each mine annually. Contacts with the mining industry are maintained in order to keep abreast of development in technology and discount rates. Technical papers and literature are collected, indexed, and placed in the listing of references for each mine appraisal report. Detailed production statistics are maintained in order to analyze the historical performance for the mine.

Table 1. Copper and molybdenum production in 1992, by mine and company

[Leaders (--), no production. (xx), not applicable]

Company Mine Ore/process type	Copper ore mined (tons)	Copper ore milled (tons)	Recoverable copper (pounds)	Recoverable molybdenum (pounds)	Waste removed (tons)
Arimteco International Inc.					
Emerald Isle (1					
Heap leach/SX-EW	94,735	--	576,459	--	63,530
Johnson (2					
Heap leach/SX-EW	1,905,280	--	8,156,435	--	2,209,860
Company total	2,000,015	--	8,732,894	--	2,273,390
Asarco Inc.					
Mission					
Sulfide	18,614,900	19,859,100	206,321,800	--	47,119,700
Ray					
Sulfide	19,298,908	19,298,908	246,772,985	--	57,556,318
Oxide	4,402,410	--	--	--	--
Heap leach/SX-EW	--	--	58,226,000	--	--
Dump leach/SX-EW	--	--	26,110,000	--	--
San Xavier North					
Sulfide	1,244,200	(3	(3	--	1,391,800
Silver Bell					
Dump leach/cement.	--	--	6,650,000	--	--
Company total	43,560,418	39,158,008	544,080,785	--	106,067,818
Cyprus Copper Co.					
Bagdad					
Sulfide	28,993,636	27,851,415	209,832,000	9,998,000	18,221,867
Dump leach/SX-EW	4,986,003	--	19,470,000	--	--
Casa Grande					
In-situ/SX-EW	--	--	2,000,000	--	--
Miami (2					
Oxide	28,222,000	--	--	--	23,337,000
Heap leach/SX-EW	--	--	124,575,000	--	--
Mineral Park					
In-situ/cementation	--	--	2,000,000	--	--
Dump leach/cement.	--	--	2,000,000	--	--
Sierrita					
Sulfide	30,924,000	29,466,000	138,540,000	13,899,000	9,392,000
Dump leach/SX-EW	19,150,000	--	9,300,000	--	--
Twin Buttes					
Sulfide (4	6,131,000	6,054,000	99,249,000	1,392,000	5,580,000
Oxide	1,548,000	--	--	--	--
Vat/SX-EW (5	--	--	40,895,000	--	--
Company total	119,954,639	63,371,415	647,861,000	25,289,000	56,530,867
Magma Copper Co.					
Miami					
In-situ/SX-EW	--	--	11,794,000	--	--
No. 2 Tailings/SX-EW	--	--	7,710,000	--	--
Pinto Valley					
Sulfide	22,793,000	23,133,000	162,086,000	1,428,000	29,644,000
Dump leach/SX-EW	--	--	18,245,000	--	--

Table 15. Copper exports of the United States, by country — continued

[Copper content in short tons. Leaders (--), no data. (na), not available at time of publication]

	1988	1989	1990	1991	1992
Rod, Bar & Other					
Copper	5,183	34,603	27,846	24,130	35,322
Copper Alloy	24,480	50,430	54,171	44,416	52,572
Tube & Pipe					
Copper	17,078	44,702	35,270	43,053	43,351
Copper Alloy	20,618	9,436	11,163	12,431	12,240
Copper Exports of Copper Imports of the United States (4					
Blister & Anodes	10	--	2	--	--
Refined Cathodes & Shapes	2,261	13,291	1,714	692	222
Copper Waste & Scrap	523	286	431	336	127
Copper Alloy Waste & Scrap (1	609	2,184	1,054	806	767

(1) Copper alloy content.

(2) Thousands of pounds.

(3) 1988 data combines copper and copper alloys as well as not backed and backed.

1989 separates copper and copper alloys and includes only not backed.

(4) Copper content.

Source: "Non-ferrous Metal Data 1992," American Bureau of Metal Statistics Inc.,

Table 15. Copper exports of the United States, by country — continued

[Copper content in short tons. Leaders (--), no data. (na), not available at time of publication]

	1988	1989	1990	1991	1992
Other Countries	145	100	149	47	99
Copper Alloy Waste & Scrap (1)	220,405	234,284	203,677	193,207	159,723
Canada	26,023	33,069	11,073	16,670	19,403
Mexico	11,127	16,322	13,180	4,068	3,290
Trinidad	1,053	164	795	404	275
Brazil	649	1,964	251	1,402	720
Venezuela	165	99	--	433	448
Belgium	9,607	6,466	6,820	3,775	3,364
Finland	--	--	--	2,296	--
France	770	837	644	241	56
Germany	23,133	44,054	15,353	2,670	1,111
Italy	2,148	5,458	12,966	1,630	1,135
Netherlands	1,229	3,347	4,821	250	488
Portugal	--	84	--	--	--
Spain	11,132	4,589	877	319	54
Sweden	1,780	2,319	3,605	860	1,733
Switzerland	59	9	--	--	--
United Kingdom	2,974	6,023	2,504	958	752
China	1,146	9,377	16,267	25,033	58,209
Hong Kong	227	1,581	3,693	7,579	7,919
India	14,533	28,169	36,232	14,694	15,873
Indonesia	--	--	--	747	541
Japan	18,988	20,558	31,667	47,175	13,044
South Korea	48,550	32,151	28,896	46,733	23,984
Pakistan	--	37	36	111	--
Philippines	--	92	--	--	--
Singapore	1,254	1,339	2,557	1,937	805
Taiwan	43,647	15,732	9,641	12,381	5,123
Thailand	--	118	145	516	917
South Africa	--	98	712	2	--
Australia	--	38	347	50	--
Other Countries	211	190	595	273	479
Master Alloys	1,034	631	762	747	1,335
Unwrought Alloys	8,695	6,651	9,459	9,499	8,986
Copper And Copper Alloy Exports of Brass Mill Products (2)					
Strip, Sheet & Plate					
Copper	1,903	7,504	15,550	13,477	14,218
Copper Alloy	34,526	18,526	32,193	31,802	27,852
Foil (3)					
Copper & Copper Alloy	5,074	3,694	6,318	6,257	12,727
Copper	n.a.	1,069	1,592	4,929	8,582
Copper Alloy	n.a.	2,625	4,726	1,328	4,145
Wire					
Copper Alloy	16,725	8,592	14,454	19,283	29,789

Table 1. Copper and molybdenum production in 1992, by mine and company — continued

Company Mine Ore/process type	Copper ore mined (tons)	Copper ore milled (tons)	Recoverable copper (pounds)	Recoverable molybdenum (pounds)	Waste removed (tons)
San Manuel					
Underground sulfide	19,957,505	19,986,868	219,262,345	3,788,372	--
In-situ/SX-EW	--	--	23,832,897	--	--
Open pit-sulfide	128,125	61,264	763,703	--	--
Open pit-oxide	11,371,158	--	--	--	13,915,577
Heap leach/SX-EW	--	--	86,282,426	--	--
Superior					
Sulfide (6)	238,407	325,150	24,401,786	--	84,159
Company total	54,488,195	43,506,282	554,378,157	5,216,372	43,643,736
Oracle Ridge Mining					
Oracle Ridge					
Sulfide	191,865	224,507	6,858,000	--	24,698
Company total	191,865	224,507	6,858,000	--	24,698
Phelps Dodge Corp.					
Copper Queen					
Dump leach/cement.	--	--	2,422,000	--	--
Morenci (7)					
Sulfide	46,600,000	46,600,000	453,000,000	264,800	132,400,000
Oxide	24,500,000	--	--	--	--
Dump leach/SX-EW	--	--	325,600,000	--	--
Company total	71,100,000	46,600,000	781,022,000	264,800	132,400,000
Subtotals by process type					
Flotation	195,115,546	192,860,212	1,767,087,619	30,770,172	315,330,119
Leach	96,179,586	xx	775,845,217	--	39,525,967
Dump/SX-EW	xx	xx	406,435,000	--	xx
Heap leach/SX-EW	xx	xx	277,816,320	--	xx
In-situ/SX-EW	xx	xx	37,626,897	--	xx
Vat agitation/SX-EW	1,548,000	xx	40,895,000	--	xx
SX-EW total	xx	xx	762,773,217	--	xx
Dump/cementation	xx	xx	11,072,000	--	xx
In-situ/cementation	xx	xx	2,000,000	--	xx
Cementation total	xx	xx	13,072,000	--	xx
Arizona total	291,295,132	192,860,212	2,542,932,836	30,770,172	340,940,509

(1) Began production July 1992.

(2) Although some of this production is from old dumps, it is undifferentiated and reported as heap leach.

(3) Ore milled and copper recovered reported with Mission.

(4) Sulfide ore is concentrated at Sierrita.

(5) Includes production from ore stockpiles, reclaimed sulfide tailings, and newly mined ore.

(6) Waste is mixed with ore and milled.

(7) Includes Sumitomo's 15%. All waste is low-grade material that is dump leached.

Table 2a. Concentrate production, by mine

[Copper production in thousand pounds. Leaders (--), no production]

Company/Mine	1982	1983	1984	1985	1986	1987
Asarco Inc.						
Mission (1)	193,055	127,229	95,052	117,711	123,231	117,195
Ray (2)	76,819	54,163	174,554	148,256	143,237	144,803
Sacaton	41,784	37,587	8,993	--	--	--
San Xavier	25,608	22,566	18,866	--	--	--
Silver Bell	--	7,647	23,613	--	--	--
Cyprus Copper Co.						
Bagdad	160,073	148,783	37	161,690	159,883	165,632
Casa Grande (4)	--	34,276	--	--	--	--
Johnson	2,511	9,717	--	--	--	--
Miami (5)	72,320	83,256	71,431	68,944	5,318	--
Sierrita/Esperanza (6)	104,537	130,402	174,131	215,500	163,020	150,000
Twin Buttes (7)	175,347	12,666	--	--	--	--
Magma Copper Co.						
Pinto Valley/Miami	84,691	--	83,042	149,886	143,141	128,376
San Manuel UG	213,482	199,409	226,186	186,779	196,138	190,900
San Manuel OP	--	--	--	--	--	--
Superior	51,265	--	--	--	--	--
Oracle Ridge Mining						
Oracle Ridge	--	--	--	--	--	--
Phelps Dodge Corp.						
Morenci	151,472	287,210	374,800	462,065	518,388	485,320
New Cornelia	21,255	74,600	47,642	--	--	--
Total	1,374,219	1,229,511	1,298,347	1,510,831	1,452,356	1,382,226
Percent of primary copper produced (9)	80.4	81.2	82	85	82.9	80.2

(1) Includes production from Cyprus Pima in 1982 and ANAMAX and Asarco Eisenhower for 1982-1984.

(2) Acquired from Kennecott, November 18, 1986.

(3) San Xavier production included with Mission in 1992.

(4) Noranda Lakeshore through 6/31/87. Became Cyprus Casa Grande July, 1988.

(5) Acquired from Inspiration, July 1, 1988 and renamed Miami.

(6) Acquired Sierrita/Esperanza from Duval, April 1, 1986.

(7) Operated by ANAMAX through 1983. Acquired by Cyprus March, 1988.

(9) Leach copper compared to total copper produced as reported in this report, Table 1.

Table 15. Copper exports of the United States, by country — continued

[Copper content in short tons. Leaders (--), no data. (na), not available at time of publication]

	1988	1989	1990	1991	1992
Honduras	--	291	75	5	7
Mexico	9,409	8,097	6,214	7,939	4,927
Brazil	56	19	--	--	--
Chile	--	70	--	--	--
Venezuela	--	1,429	5,216	2,359	70
Belgium	234	21	2,442	337	175
France	1,660	760	1,567	1,316	958
Germany	1,456	1,430	1,068	2,043	1,145
Italy	4,984	652	748	1,306	1,057
Netherlands	9,583	731	3,714	3,416	1,899
Switzerland	137	249	115	81	103
United Kingdom	2,729	1,197	1,090	1,937	500
China	3,905	15,727	3,911	15,278	49,777
Hong Kong	592	644	1,580	2,923	10,283
Indonesia	--	--	2,088	773	439
Japan	14,877	53,374	113,720	143,635	59,123
South Korea	6,755	1,374	8,668	13,326	884
Malaysia	512	--	--	880	17
Philippines	106	2	--	--	--
Singapore	1,410	1,328	1,580	4,070	457
Taiwan	1,776	53,729	72,930	87,425	61,319
Thailand	--	--	2,376	5,541	5,177
Egypt	--	--	168	--	--
Other Countries	155	130	268	310	174
Copper Waste & Scrap	132,025	170,789	153,907	144,749	111,531
Canada	32,159	41,956	55,651	36,363	29,612
Jamaica	--	--	--	44	--
Mexico	12,672	8,639	9,789	8,264	329
Brazil	655	892	846	400	190
Chile	--	140	--	--	--
Venezuela	337	20	--	--	--
Belgium	3,100	3,991	403	103	110
France	--	59	436	--	--
Germany	10,748	14,570	6,294	572	238
Italy	920	280	1,080	22	152
Netherlands	1,019	3,779	793	174	52
Norway	118	245	289	107	--
Spain	3,725	958	168	22	--
Switzerland	17	122	--	--	--
United Kingdom	2,547	1,354	969	91	39
China	470	6,666	8,592	25,213	26,312
Hong Kong	1,579	1,242	1,003	6,045	9,332
India	2,222	1,203	434	652	107
Indonesia	--	456	39	313	35
Japan	17,780	22,411	19,622	26,149	28,055
South Korea	21,540	35,936	35,584	32,506	13,694
Malaysia	--	--	--	96	43
Pakistan	--	--	--	96	--
Philippines	--	133	44	25	--
Singapore	2,313	134	64	932	1,166
Taiwan	17,959	25,503	11,658	6,513	1,966

Table 15. Copper exports of the United States, by country

[Copper content in short tons. Leaders (--), no data. (na), not available at time of publication]

	1988	1989	1990	1991	1992
Ores, Concentrates, Mattes & Cement	239,438	304,288	287,597	267,161	293,469
Canada	9,367	15,212	20,604	44,126	59,113
Jamaica	--	--	--	197	--
Mexico	2,151	921	1,482	3,200	34,046
Brazil	--	18,335	15,675	40,372	1,705
Belgium	--	265	--	--	--
Bulgaria	--	5,026	--	6,492	5,701
C.I.S.	--	--	--	--	2,979
Finland	1,967	7,982	4,461	7,765	--
France	--	110	33	--	--
Germany	45,808	15,419	153	183	151
Italy	--	--	165	226	304
Spain	--	15	104	3,064	6,943
United Kingdom	--	555	575	372	456
Yugoslavia	--	6,211	--	--	--
China	10,316	4,028	19,539	42,287	15,265
Hong Kong	--	4	12,233	57	19
Indonesia	--	136	--	85	--
Israel	--	4	38	126	5
Japan	149,762	178,088	188,280	82,666	106,347
Korea, South	13,225	37,734	20,744	13,069	34,211
Malaysia	--	170	95	--	--
Philippines	3,511	4,117	3,089	19,676	16,847
Taiwan	3,291	9,605	64	2,977	27
Australia	--	251	185	43	9,233
Other Countries	40	100	78	178	117
Blister & Anodes	36,023	6,083	7,077	23,468	18,660
Canada	10,818	3,494	3,842	14,660	17,624
Mexico	584	139	218	55	25
Chile	--	472	--	--	--
Germany	5,421	42	21	109	--
Italy	--	5	52	--	--
Spain	1,164	--	59	87	--
United Kingdom	--	43	--	37	16
China	--	--	--	119	--
Hong Kong	740	627	759	607	87
Japan	--	180	885	1,084	362
South Korea	16,279	30	81	2,079	42
Saudi Arabia	--	114	--	--	--
Singapore	217	122	127	2	9
Taiwan	588	606	893	4,584	250
Ghana	--	39	66	16	122
Australia	--	--	--	--	51
Other Countries	212	170	74	29	72
Refined Cathodes & Shapes	64,574	147,106	232,769	298,211	208,424
Canada	4,238	5,215	2,236	2,075	9,403
Costa Rica	--	436	866	971	314
Dominican Republic	--	93	--	--	204
El Salvador	--	108	129	265	12

Table 2a. Concentrate production, by mine — continued

Company/Mine	1988	1989	1990	1991	1992
Asarco Inc.					
Mission (x	130,364	117,243	133,973	172,043	206,322
Ray (3	157,141	153,879	161,855	149,453	246,773
Sacaton	--	--	--	--	--
San Xavier	--	26,765	25,528	4,864	(3
Silver Bell	--	--	--	--	--
Cyprus Copper Co.					
Bagdad	181,500	176,372	191,653	196,852	209,832
Casa Grande (4	--	--	--	--	--
Johnson	--	--	--	--	--
Miami (5	--	--	--	--	--
Sierrita/Esperanza (6	166,603	151,800	155,071	134,014	138,540
Twin Buttes (7	11,784	67,322	81,925	96,774	99,249
Magma Copper Co.					
Pinto Valley/Miami	133,686	162,550	161,720	146,261	162,086
San Manuel UG (8	183,042	180,793	185,211	221,861	219,262
San Manuel OP (8	220	976	--	114	764
Superior	--	--	5,777	25,167	24,402
Oracle Ridge Mining					
Oracle Ridge	--	--	--	4,483	6,858
Phelps Dodge Corp.					
Morenci	485,835	471,412	470,505	445,500	453,000
New Cornelia	--	--	--	--	--
Total	1,450,175	1,509,112	1,573,218	1,597,386	1,767,088
Percent of primary copper produced (9	76.9	75.1	72.3	70.5	69.5

Figure 2a. Concentrate production 1982 - 1992

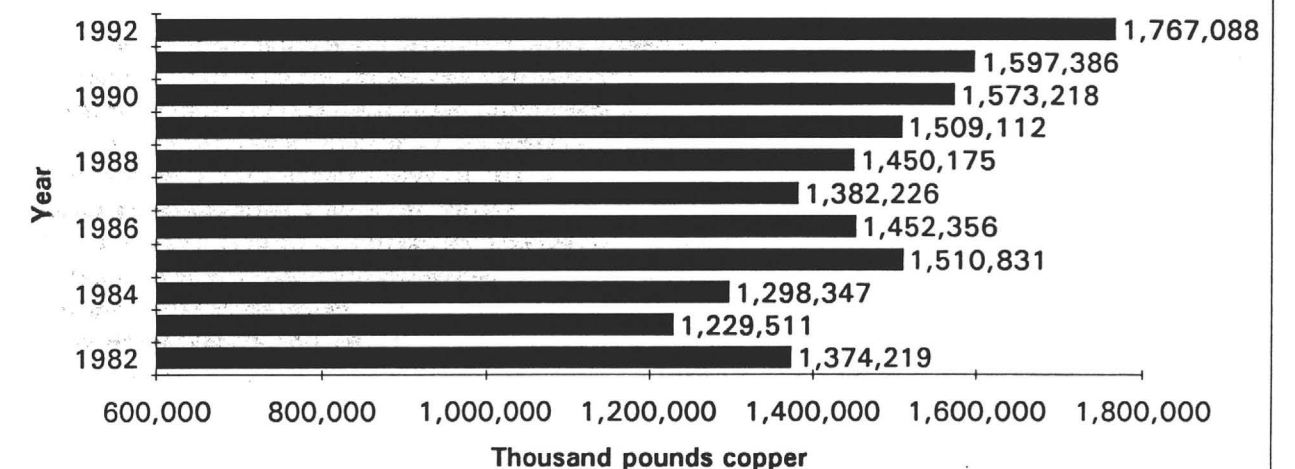


Table 2b. Leach copper production, by mine

[Copper production in thousand pounds. Includes copper recovered by precipitation or SX-EW from material dump, vat, heap, or in-situ leached. Leaders (--), no production]

Company/Mine	1982	1983	1984	1985	1986	1987
Arimetco International Inc.						
Emerald Isle	--	--	--	--	--	--
Johnson (1	9,702	--	8,803	6,200	--	--
Van Dyke (2	--	--	--	--	--	--
Asarco Inc.						
Ray (3	22,420	20,033	20,457	23,706	56,639	68,543
Silver Bell	8,687	10,374	9,152	8,800	6,814	12,800
Cyprus Copper Co.						
Bagdad	13,173	13,282	14	14,259	13,958	16,470
Casa Grande (4	45,611	3,244	15,401	13,514	7,100	4,145
Miami (5	50,000	78,988	79,549	85,136	98,747	105,555
Mineral Park (6	3,191	3,101	2,718	3,798	4,251	4,405
Ox Hide (5	1,572	--	--	--	--	--
Sierrita/Esperanza (6	9,354	6,367	8,500	10,000	8,770	7,943
Twin Buttes (7	60,796	50,649	50,239	19,824	--	--
Magma Copper Co.						
Copper Cities	2,046	--	--	--	--	--
Pinto Valley/Miami	26,958	24,632	25,602	23,947	22,252	22,724
San Manuel (8	--	--	--	--	21,923	51,278
Phelps Dodge Corp.						
Copper Queen	4,545	5,200	3,493	4,144	3,454	2,730
Morenci	75,735	69,158	60,312	53,228	56,261	45,249
New Cornelia	661	--	920	402	--	--
Total	334,451	285,028	285,160	266,958	300,169	341,842
Percent of primary copper produced (9	19.6	18.8	18.0	15.0	17.1	19.8

(1 Acquired from Cyprus, August, 1989.

(2 Operated by Kocide 1988-89. Acquired by Arimetco in 1990.

(3 Acquired from Kennecott, November 18, 1986.

(4 Noranda Lakeshore through 6/31/87. Became Cyprus Casa Grande July, 1988.

(5 Acquired from Inspiration, July 1, 1988 and renamed Miami.

(6 Cyprus acquired Sierrita/Esperanza and Mineral Park from Duval April 1, 1986.

(7 Operated by ANAMAX through 1985. Acquired by Cyprus March, 1988.

(8 Open pit, heap leach, SX-EW start-up in spring of 1986. Some in-situ production.

(9 Leach copper compared to total copper produced as reported in this report, Table1.

Table 14. Copper imports of the United States, by country — continued

[Copper content in short tons. Leaders (--), no data]

	1988	1989	1990	1991	1992
Master Alloys	889	743	1,017	742	936
Unwrought Alloys	11,547	4,487	1,506	2,785	13,302
Copper and Copper Alloy Imports Of Brass Mill Products (2					
Strip, Sheet & Plate					
Copper	37,167	37,859	39,266	36,448	28,957
Copper Alloy	99,981	81,235	70,763	59,029	51,394
Foil					
Copper					
Copper Alloy	44,945	33,957	43,190	42,723	43,658
	22,677	27,216	26,311	24,037	24,717
Wire					
Copper Alloy	25,028	22,143	22,353	18,661	21,460
Rod, Bar & Other					
Copper	31,474	29,617	31,155	25,580	33,899
Copper Alloy	74,634	75,622	61,137	44,345	44,703
Tube & Pipe					
Copper	91,924	72,896	46,565	28,822	24,984
Copper Alloy	59,493	66,882	57,430	51,209	55,058

(1 Copper alloy content.

(2 Thousands of pounds.

Source:"Non-ferrous Metal Data 1992," American Bureau of Metal Statistics Inc.,

Table 14. Copper imports of the United States, by country — continued

[Copper content in short tons. Leaders (--), no data]

	1988	1989	1990	1991	1992
Yugoslavia	2,199	--	--	--	--
China	845	71	153	--	--
Hong Kong	711	--	--	--	--
Japan	--	3	--	4,957	450
Syria	--	--	20	--	--
Niger	--	912	--	--	--
South Africa	1,985	1,193	830	165	--
Zaire	35,143	12,607	3,469	--	2,210
Zambia	--	--	689	--	--
Australia	--	--	--	73	11
Other Countries	62	15	--	2	98
Copper Waste & Scrap	40,952	34,808	39,579	31,685	57,787
Canada	28,860	21,350	25,723	21,591	32,646
Bahamas	37	17	--	--	--
Barbados	72	56	80	43	71
Costa Rica	224	594	582	896	748
Dominican Republic	648	515	450	377	611
El Salvador	--	--	106	303	16
Guatemala	205	267	491	242	629
Haiti	--	49	41	62	--
Honduras	53	38	57	203	381
Jamaica	194	207	363	621	632
Mexico	8,036	3,933	4,013	3,590	11,251
Antilles Netherlands	139	31	109	36	--
Nicaragua	--	--	--	--	370
Panama	977	703	655	433	902
St. Vincent	--	14	33	--	--
Trinidad	209	336	151	187	225
Brazil	--	--	194	--	--
Chile	79	5,296	4,024	1,111	2,763
Ecuador	--	--	--	--	52
Peru	--	--	--	--	164
Suriname	48	--	--	--	--
Venezuela	628	648	1,661	1,177	2,224
Estonia	--	--	--	--	654
Finland	--	--	--	64	16
France	119	--	--	--	--
Germany	111	325	--	--	--
Netherlands	--	304	466	85	759
Russia	--	--	--	--	580
Spain	--	--	--	--	1,249
United Kingdom	42	1	58	112	395
Japan	--	--	79	--	--
South Korea	48	7	--	--	--
Malaysia	--	--	61	--	69
Taiwan	27	--	--	--	--
Ghana	--	--	23	--	--
Other Countries	196	117	159	552	380
Copper Alloy Waste & Scrap (1)	55,146	87,435	108,809	107,100	128,199
Canada	31,120	42,720	69,333	60,439	68,905

Table 2b. Leach copper production, by mine — continued

Company/Mine	1988	1989	1990	1991	1992
Arimetco International Inc.					
Emerald Isle	--	48	26	--	576
Johnson (2)	--	--	2,852	5,898	8,156
Van Dyke (3)	67	654	--	--	--
Asarco Inc.					
Ray (4)	76,966	79,933	81,797	85,238	84,336
Silver Bell	8,660	10,017	8,480	8,059	6,650
Cyprus Copper Co.					
Bagdad	19,100	22,262	23,419	22,391	19,470
Casa Grande (5)	4,300	5,000	2,500	6,864	2,000
Miami (6)	115,293	124,367	121,702	121,224	124,575
Mineral Park (7)	4,500	3,338	4,000	3,800	4,000
Ox Hide (6)	--	--	--	--	--
Sierrita/Esperanza (7)	8,556	8,400	9,383	9,337	9,300
Twin Buttes (8)	--	18,800	30,919	37,597	40,895
Magma Copper Co.					
Copper Cities	--	--	--	--	--
Pinto Valley/Miami	23,413	21,013	31,955	34,535	37,749
San Manuel (9)	62,956	68,855	80,400	91,562	110,115
Phelps Dodge Corp.					
Copper Queen	2,700	4,762	3,100	2,280	2,422
Morenci	108,426	133,221	200,823	238,900	325,600
New Cornelia	--	--	--	--	--
Total	434,937	500,670	601,356	667,685	775,844
Percent of primary copper produced (9)	23.1	24.9	27.7	29.5	30.5

Figure 2b. Leach copper production 1982 - 1992

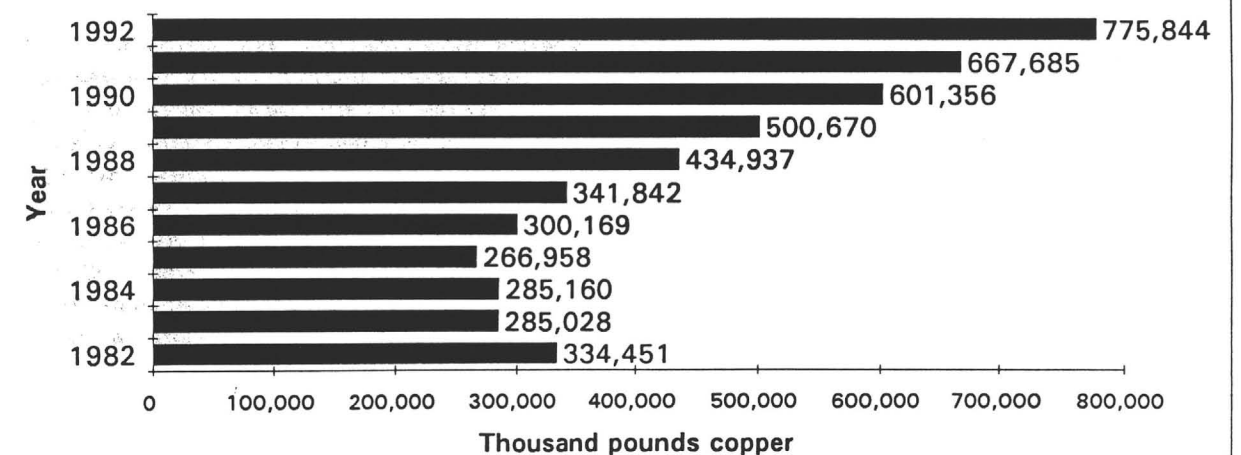


Table 3. Company rank in 1992, by copper and molybdenum production

Copper			Molybdenum		
Rank	Company	Percent	Rank	Company	Percent
1	Phelps Dodge Corp.	30.71	1	Cyprus Copper Co.	82.19
2	Cyprus Copper Co.	25.48	2	Magma Copper Co.	16.95
3	Magma Copper Co.	21.80	3	Phelps Dodge Corp.	0.86
4	Asarco Inc.	21.40			
5	Arimetco Int. Inc.	0.34			
6	Oracle Ridge Mining	0.27			

Figure 3. Copper production by company

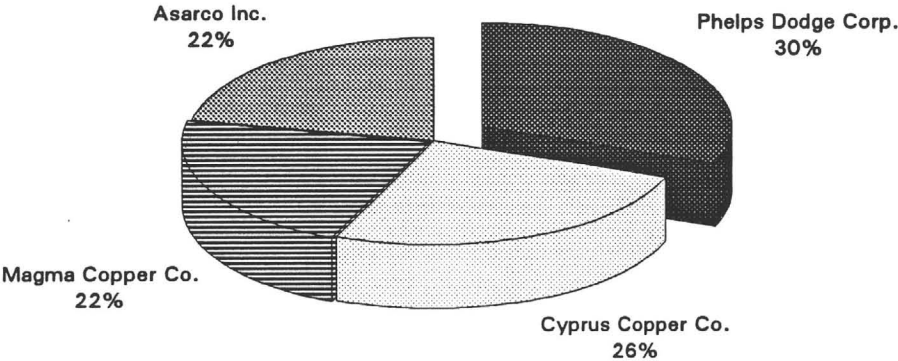


Figure 4. Molybdenum production by company

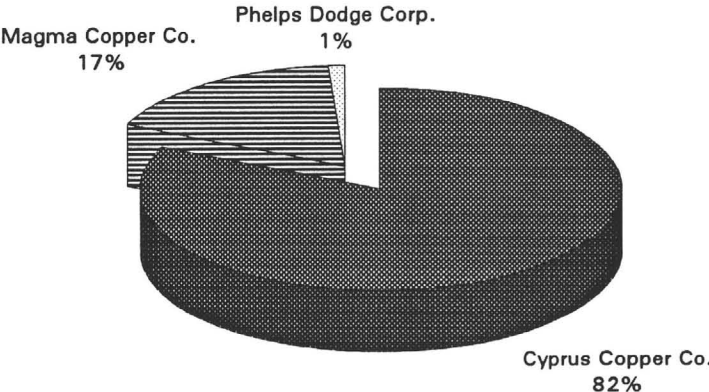


Table 14. Copper imports of the United States, by country — continued

[Copper content in short tons. Leaders (--), no data]					
	1988	1989	1990	1991	1992
Bahamas	--	67	--	--	152
Barbados	--	35	--	51	9
Bermuda	--	--	--	64	156
Cayman Islands	--	--	--	32	74
Costa Rica	--	146	168	119	227
Dominican Republic	962	1,177	1,174	1,515	1,596
Guatemala	137	346	290	319	190
Haiti	142	118	189	159	--
Honduras	107	68	--	537	570
Jamaica	204	353	595	250	321
Mexico	14,180	22,825	24,542	29,981	34,653
Netherlands Antilles	249	340	560	632	695
Nicaragua	--	--	195	709	750
Panama	739	935	735	1,060	739
St. Vincent	--	58	--	--	--
Trinidad	306	332	261	280	80
Brazil	--	--	--	83	6
Chile	1,992	3,690	214	42	16
Colombia	--	--	2,665	2,262	861
Guyana	--	18	365	480	46
Peru	144	--	--	600	631
Suriname	--	--	--	--	45
Uruguay	--	--	--	--	46
Venezuela	1,040	6,772	4,915	4,144	6,479
Belgium	1,675	1,577	--	--	--
Estonia	--	--	--	--	1,022
Finland	--	--	177	--	179
France	--	206	212	350	118
Germany	251	234	230	220	308
Italy	--	21	--	--	--
Netherlands	--	--	--	40	78
Portugal	--	33	--	31	60
Russia	--	--	--	--	328
Slovenia	--	--	--	--	378
Sweden	--	21	--	129	1,228
Switzerland	--	47	--	--	123
United Kingdom	290	302	138	893	2,884
China	82	150	--	--	--
Hong Kong	145	102	--	37	1,613
Indonesia	--	--	--	40	54
Israel	--	--	--	--	166
Japan	210	336	212	100	417
South Korea	--	95	--	--	--
Malaysia	--	47	267	306	366
Philippines	--	15	--	258	420
Singapore	--	195	153	220	195
Taiwan	358	3,835	202	185	299
South Africa	--	--	--	28	82
Australia	--	--	--	153	136
Kiribati	--	--	--	41	--
Marshall Islands	--	--	163	15	--
Other Countries	813	219	854	296	498

Table 14. Copper imports of the United States, by country

[Copper content in short tons. Leaders (--), no data]

	1988	1989	1990	1991	1992
Ores, Concentrates, Mattes & Cement	9,101	52,264	159,762	68,750	107,316
Canada	178	--	--	--	13,436
Mexico	6,822	47,581	142,236	52,926	38,286
Chile	34	3,931	--	--	924
Peru	55	--	66	--	--
Ireland	1	--	--	--	--
Monaco	--	76	--	--	--
Portugal	--	--	17,460	3,786	4,100
Sweden	--	661	--	--	--
United Kingdom	--	3	--	--	--
Indonesia	--	--	--	11,984	45,565
Philippines	--	--	--	--	4,983
Mozambique	--	12	--	--	--
Australia	2	--	--	--	--
Papua New Guinea	2,009	--	--	--	--
Other Countries	--	--	--	54	22
Blister & Anodes	108,505	85,117	48,806	66,537	64,161
Canada	--	207	2	2	21
Mexico	1,145	7,325	17,271	1,668	16,104
Chile	53,206	37,982	15,389	30,783	25,648
Peru	3,282	3,254	3,948	19,775	18,487
Germany	--	--	38	125	116
Sweden	--	--	--	--	4
Switzerland	2	--	--	--	--
Japan	32,150	24,580	3,854	13,088	127
Cote D'Ivoire	5,647	--	--	--	--
Namibia	--	--	141	--	3,654
South Africa	9,815	--	--	--	--
Tanzania	--	1,088	--	--	--
Zaire	3,258	10,681	8,163	1,096	--
Refined Cathodes & Shapes	367,150	334,884	288,441	318,108	318,727
Canada	195,996	199,312	203,171	218,172	247,023
Mexico	46	181	81	--	2,216
Brazil	1,319	20,085	11,247	27,566	9,740
Chile	91,211	87,226	62,334	54,909	46,380
Peru	14,848	10,186	2,672	5,871	9,182
Venezuela	137	--	110	--	--
Austria	495	21	10	--	--
Belgium	1,396	--	--	82	--
Finland	441	--	--	--	332
Germany	5,573	310	170	301	674
Netherlands	5,567	2,680	--	4,043	--
Norway	390	61	761	--	--
Poland	714	--	--	--	--
Portugal	--	--	1,091	--	--
Spain	3,530	--	242	1,108	--
Sweden	4,157	--	1,104	858	--
Switzerland	385	--	287	1	411
United Kingdom	--	21	--	--	--

Table 4. Mine rank in 1992, by copper and molybdenum production

Rank	Mine/Company	Production (pounds)	% of total
Copper			
1	Morenci/Phelps Dodge Corp.	778,600,000	30.6
2	Ray/Asarco Inc.	331,108,985	13.0
3	San Manuel/Magma Copper Co.	330,141,371	13.0
4	Bagdad/Cyprus Copper Co.	229,302,000	9.0
5	Mission/Asarco Inc. (1	206,321,800	8.1
6	Pinto Valley/Magma Copper Co.	180,331,000	7.1
7	Sierrita/Cyprus Copper Co.	147,840,000	5.8
8	Twin Buttes/Cyprus Copper Co.	140,144,000	5.5
9	Miami/Cyprus Copper Co.	124,575,000	4.9
10	Superior/Magma Copper Co.	24,401,786	1.0
11	Miami/Magma Copper Co.	19,504,000	0.8
12	Silver Bell/Asarco Inc.	6,650,000	0.3
13	Johnson/Arimetco International Inc.	8,156,435	0.3
14	Oracle Ridge/Oracle Ridge Mining	6,858,000	0.3
15	Mineral Park/Cyprus Copper Co.	4,000,000	0.2
16	Copper Queen/Phelps Dodge Corp.	2,422,000	0.1
17	Casa Grande/Cyprus Copper Co.	2,000,000	0.1
18	Emerald Isle/Arimetco International Inc.	576,459	0.0
Total		2,542,932,836	100.0
Molybdenum			
1	Sierrita/Cyprus Copper Co.	13,899,000	45.2
2	Bagdad/Cyprus Copper Co.	9,998,000	32.5
3	San Manuel/Magma Copper Co.	3,788,372	12.3
4	Pinto Valley/Magma Copper Co.	1,428,000	4.6
5	Twin Buttes/Cyprus Copper Co.	1,392,000	4.5
6	Morenci/Phelps Dodge Corp.	264,800	0.9
Total		30,770,172	100.0

(1 Includes copper production from San Xavier North.

Table 5. Monthly and cumulative copper mine production

[Percentage change column shows change from corresponding period in prior year]

	1988		1989		1990		1991		1992	
	Tons	% Change	Tons	% Change	Tons	% Change	Tons	% Change	Tons	% Change
January	77,612	8.1	81,455	5.0	84,172	2.0	93,712	11.3	92,565	-1.2
February	73,465	12.2	79,227	7.8	78,045	-2.8	86,205	10.5	89,556	3.9
March	82,552	13.6	91,491	10.8	85,658	-7.4	90,468	5.6	101,677	12.4
April	76,379	12.9	79,549	4.2	88,073	9.3	86,126	-2.2	101,379	17.1
May	77,872	11.5	82,315	5.7	91,460	9.7	101,955	11.5	106,917	4.9
June	75,089	8.8	78,643	4.7	92,701	16.3	95,312	2.8	108,787	14.1
July	77,316	13.5	80,152	3.7	92,258	13.6	97,937	6.2	112,114	14.5
August	82,747	18.9	84,995	2.7	90,685	5.4	100,611	10.9	109,491	8.8
September	77,467	11.5	80,169	3.5	89,107	9.7	93,623	5.1	111,429	19.0
October	79,386	11.1	82,790	4.3	93,941	11.7	99,787	6.2	109,781	10.0
November	76,173	1.1	77,303	1.5	93,320	18.8	94,279	1.0	109,421	16.1
December	80,906	5.2	81,502	0.7	93,037	11.8	93,590	0.6	112,236	19.9
Cumulative year to date										
January	77,612	8.1	81,455	5.0	84,172	2.0	93,712	11.3	92,565	-1.2
February	151,077	10.1	160,682	6.4	162,217	-0.4	179,917	10.9	182,121	1.2
March	233,629	11.3	252,173	7.9	247,875	-2.9	270,385	9.1	283,798	5.0
April	310,008	11.7	331,722	7.0	335,948	0.0	356,511	6.1	385,798	8.0
May	387,880	11.6	414,037	6.7	427,408	1.9	458,466	7.3	492,094	7.3
June	462,969	11.2	492,680	6.4	520,109	4.2	553,778	6.5	600,881	8.5
July	540,285	11.5	572,832	6.0	612,367	5.5	651,715	6.4	712,995	9.4
August	623,032	13.3	657,827	5.6	703,052	5.5	752,326	7.0	822,486	9.3
September	700,499	12.3	737,996	5.4	792,159	5.9	845,949	6.8	933,915	10.4
October	779,885	12.2	820,786	5.2	886,100	6.5	945,736	6.7	1,043,696	10.4
November	856,058	11.1	898,089	4.9	979,420	7.5	1,040,015	6.2	1,153,117	10.9
December	936,964	11.2	979,591	4.5	1,072,457	7.9	1,133,605	5.7	1,265,353	11.6
Average	78,080	10.6	81,633	4.5	89,371	7.9	94,467	5.7	104,482	10.5

Source: U.S. Bureau of Mines

Table 13. United States copper production, by company

[Copper content (tons) of mine production unless otherwise noted.]

Leaders (--), no production. (na), not available]

Company	1988	1989	1990	1991	1992
Arimetco International Inc. (1)	--	--	2,254	4,858	8,950
Asarco Inc.	206,000	235,700	266,400	279,900	338,400
Cominco American Inc./Dresser Minerals (2)	1,671	1,489	1,586	1,385	1,653
Copper Range Co. (3)	45,802	52,061	51,104	59,498	68,539
Cyprus Copper Co.	233,242	293,451	312,102	313,498	322,500
The Doe Run Company	22,936	20,220	13,261	10,894	8,773
Hecla Mining Co. (4)	481	460	250	423	239
Apex Mine	--	--	45	na	na
Coeur Mine (5)	47	50	43	na	na
Galena Mine (6)	125	129	113	248	110
Lucky Friday Mine	309	281	49	175	129
Kennecott Corp. (7)	245,000	244,000	251,000	251,000	307,000
Magma Copper Co. (8)	200,753	214,388	232,458	259,493	278,859
Montana Resources	53,155	39,634	37,245	47,421	49,826
Oracle Ridge Mining (9)	--	--	--	2,241	3,429
Phelps Dodge Corp.	494,500	500,500	548,400	518,100	537,000
Refiners (10)					
Asarco Inc.	484,700	492,800	482,400	492,800	509,400

(1) Data from Arimetco International Inc. annual reports.

(2) Magmont mine.

(3) Refined production.

(4) Includes Hecla's share of production from each mining property.

(5) Operated by Asarco. Shows Hecla's share of 5%. Interest terminated in 1990.

(6) Operated by Asarco. Shows Hecla's share of 25%. Interest terminated in 1992.

(7) Recoverable copper contained in concentrates and precipitates produced. Includes only Kennecott's share from jointly owned properties.

(8) Refined copper contained in concentrates produced and SX-EW production.

(9) Data reported by company to Arizona Department of Mines and Mineral Resources.

(10) The total for this concern is to a large extent a duplication of the reports of other producers.

Source: "Non-ferrous Metal Data 1992," American Bureau of Metal Statistics Inc., Arizona Department of Mines and Mineral Resources file data.

Table 12. North American copper smelter capacity in 1992

Company Smelter	Smelter location	Annual capacity (Tons of material)
United States		
Asarco Inc.		
El Paso Smelter	El Paso, TX	450,000
Hayden Smelter	Hayden, AZ	720,000
Hayden-Ray Smelter	Hayden, AZ	360,000
Chemetco Inc.	Alton, IL	150,000
Copper Range Co.	White Pine, MI	70,000
Cyprus Copper Co.		
Cyprus Miami Mining Corp.	Claypool, AZ	408,000
Kennecott Corporation		
Kennecott Utah Copper	Garfield, UT	643,000
Magma Copper Co.		
Smelting and Refining Division	San Manuel, AZ	1,050,000
Phelps Dodge Corp.		
Chino Mines	Hurley, NM	550,000
Tyrone Branch	Playas, NM	750,000
Total		5,151,000
Canada		
Falconbridge Ltd.	Falconbridge, Ontario	495,000
Hudson Bay Mining and Smelting Co. Ltd.	Flin Flon, Manitoba	340,000
Inco Ltd.	Copper Cliff, Ontario	1,800,000
Noranda Mines Inc.		
Gaspé Smelter	Murdochville, Quebec	240,000
Horne Smelter	Rouyn-Noranda, Quebec	900,000
Total		3,775,000
Mexico		
Compania Minera De Cananea, S.A.	Cananea, Sonora	277,000
Industrial Minera Mexico, S.A.	San Luis Potosi	42,000
Mexicana De Cobre, S.A. De C.V.	Nacozari, Sonora	672,000
Total		991,000
North American total		9,917,000

Source: "Non-ferrous Metal Data 1992," American Bureau of Metal Statistics Inc.

Table 6. Average copper content of ore produced

[Copper content reported as percent of total copper. Percentage in parenthesis is approximate and not used to calculate weighted average. Leaders (--), no production. (UG), underground. (OP), open pit. (do.) ditto]

Company/Mine	Ore type	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Arimetco International Inc.											
Emerald Isle	Oxide	--	--	--	--	--	--	--	--	--	0.60
Johnson (1)	Oxide	0.40	0.71	--	--	--	--	--	--	0.40	0.57
Asarco Inc.											
Mission	Sulfide	(0.75)	(0.75)	0.65	0.70	0.67	0.73	0.70	0.72	0.72	0.62
Ray (2)	do.	1.19	1.13	0.99	0.99	0.89	1.00	0.97	0.88	0.84	0.76
do.	Oxide	--	--	1.17	1.23	1.15	1.11	1.13	1.05	0.95	0.99
San Xavier	Sulfide	(0.51)	(0.51)	(4	(4	(4	(4	0.55	0.54	0.67	0.63
Cyprus Copper Co.											
Bagdad	do.	0.50	0.45	0.44	0.45	0.48	0.45	0.49	0.53	0.44	0.42
Lakeshore	Oxide	(1.00)	(1.00)	--	--	--	--	--	--	--	--
Miami (5)	Sulfide	0.53	0.55	0.60	0.54	--	--	--	--	--	--
do.	Oxide	--	0.50	0.49	0.57	0.59	0.52	0.49	0.44	0.48	0.42
Sierrita (6)	do.	(0.30)	0.34	0.33	0.34	0.33	0.30	0.31	0.31	0.28	0.28
do.	Oxide	--	--	--	--	--	--	--	--	0.15	0.18
Twin Buttes (7)	Sulfide	0.57	--	--	--	--	3.39	1.90	0.99	0.99	0.95
	Oxide	0.93	0.86	0.84	--	--	1.22	1.13	0.99	0.90	1.10
Magma Copper Co.											
Pinto Valley	Sulfide	--	0.44	0.45	0.45	0.36	0.37	0.46	0.44	0.40	0.41
San Manuel UG	do.	0.64	0.64	0.61	0.62	0.62	0.63	0.64	0.65	0.69	0.63
San Manuel OP	do.	--	--	--	--	--	--	--	--	1.08	0.82
do.	Oxide	--	--	--	0.58	0.64	0.61	0.56	0.55	0.59	0.63
Superior	Sulfide	--	--	--	--	--	--	--	5.26	5.44	5.59
Oracle Ridge Mining Partners											
Oracle Ridge	do.	--	--	--	--	--	--	--	--	1.79	1.89
Phelps Dodge Corp.											
Morenci/Metcalf	do.	0.73	0.81	0.86	0.84	0.82	0.88	0.79	0.74	0.78	0.67
do.	Oxide	--	--	--	--	--	--	--	--	0.46	0.55
New Cornelia	Sulfide	0.60	0.55	--	--	--	--	--	--	--	--
Weighted average (8)		0.65	0.70	0.62	0.61	0.58	0.60	0.62	0.58	0.57	0.53

(1 Acquired from Cyprus, August, 1989.

(2 Acquired from Kennecott, November 18, 1986.

(4 Data for San Xavier included with Mission for 1985-1988.

(5 Acquired from Inspiration, July 1, 1988.

(6 Acquired from Duval, April 1, 1986.

(7 Acquired by Cyprus, March, 1988.

(8 Weighted average grade of ore based generally on assay of total copper.

Table 7. Percent contained copper recovered

[Reported as percent of total copper. Percentage in parenthesis is an estimate.
Leaders (---), no production. (nd), no data. (do.), ditto]

Company/Mine	Ore type	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Arimetco International Inc.											
Emerald Isle	Oxide	--	--	--	--	--	--	--	--	--	75
Johnson (1	do.	62	(62)	--	--	--	--	--	--	80	50
Asarco Inc.											
Mission	Sulfide	80	(80)	92	91	89	87	84	86	87	84
Ray (2	do.	(70)	83	81	82	84	83	81	84	84	84
do.	Oxide	nd	nd	64	59	62	61	60	63	68	66
San Xavier	Sulfide	79	(80)	83	82	84	81	79	79	81	(3
Cyprus Copper Co.											
Bagdad	do.	83	92	91	93	90	91	84	70	87	90
do.	Oxide	--	52	51	54	42	46	90	91	nd	93
Miami (4	Sulfide	86	80	76	66	69	--	93	91	48	63
Sierrita (5	do.	(88)	89	92	91	89	87	86	87	87	88
Twin Buttes (6	Sulfide	--	--	--	--	--	87	83	84	87	89
do.	Oxide	(80)	80	(80)	--	--	--	72	71	nd	100
Magma Copper Co.											
Pinto Valley	Sulfide	--	88	80	84	82	84	82	86	84	90
San Manuel	do.	86	90	90	90	85	86	82	85	89	91
do.	Oxide	--	--	--	--	--	--	--	--	--	86
Superior	Sulfide	--	--	--	--	--	--	--	94	97	95
Oracle Ridge Mining Partners											
Oracle Ridge	do.	--	--	--	--	--	--	--	--	82	76
Phelps Dodge Corp.											
Morenci/Metcalf	do.	71	70	86	76	74	72	73	77	77	(73)
New Cornelia	do.	78	76	--	--	--	--	--	--	--	--

(1 Acquired from Cyprus, August, 1989.

(2 Acquired from Kennecott, November 18, 1986.

(3 San Xavier included with Mission for 1992.

(4 Percent recovery by leaching since 1986. Acquired from Inspiration, July 1, 1988.

(5 Acquired from Duval, April 1, 1987.

(6 Recovery includes ANAMAX's share of Palo Verde 1983-1984. Acquired by Cyprus, March, 1989.

Table 11. Copper mine capacity in 1992

[Figures generally represent a current estimate of the production capacity of primary recoverable copper in concentrates, precipitates, and cathodes. Figures do not represent smelter or refinery capacity. Capacities for closed operations are historic and may not be immediately available]

Mine/Company	Annual capacity (tons copper)	Basis
Morenci/Phelps DodgeCorp.	389,000	Recent production figure
Ray/Asarco Inc.	182,000	Design capacity & ore grade
San Manuel/Magma Copper Co.	164,000	Recent production figure
Sierrita &Twin Buttes/Cyprus Copper Co.	144,000	Recent production figure
Mission/Asarco Inc.	120,000	Design capacity & ore grade
Bagdad/Cyprus Copper Co.	114,000	Recent production figure
Pinto Valley/Magma Copper Co.	90,000	Recent production figure
Miami/Cyprus Copper Co.	62,000	Recent production figure
New Cornelia/Phelps Dodge Corp.	40,000	Historic data
Superior/Magma Copper Co.	20,000	Company annual report and/or 10-K
Mineral Park/Cyprus Copper Co.	17,000	Historic data
Miami & No. 2 tailings/Magma Copper Co.	10,000	Recent production figure
Christmas/Cyprus Copper Co.	8,000	Historic data
Oracle Ridge/Oracle Ridge Mining	6,000	Design capacity & ore grade
Johnson/Arimetco International Inc.	5,000	Design capacity & ore grade
Silver Bell/Asarco Inc.	4,000	Leaching only
Van Dyke/Arimetco International Inc.	3,000	Design capacity & ore grade
Casa Grande/Cyprus Copper Co.	3,000	Recent production figure
Copper Queen/Phelps Dodge Corp.	2,000	Leaching only
Total	1,383,000	

Source: Arizona Department of Mines & Mineral Resources' file data; companies' annual reports and form 10-Ks; professional publications.

Table 10. Nonfuel mineral production

[(na), not available. (xx), not applicable]

Mineral	Units	1991		1992	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays (1	short tons	251,781	\$3,830	112,808	\$463
Copper (2	short tons	1,128,845	2,468,255	1,271,220	2,731,152
Gem stones	xx	na	3,173	na	5,416
Gold (2, 3	troy ounces	199,174	72,362	213,995	73,818
Iron oxide pigments	short tons	20	22	85	62
Sand and gravel (construction) (4	short tons	22,500,000	79,400	33,842,000	123,517
Silver (2	troy ounces	4,758,304	19,212	5,304,865	20,873
Stone (crushed) (5	short tons	7,060,000	32,842	5,500,000	26,300
Combined value of cement, clays (bentonite 1992), gypsum (crude), iron ore (usable, 1991), lead (1991-92), lime, molybdenum, perlite, pumice, pyrites, salt, sand and gravel (industrial), stone (dimension), and tin (1992).	xx	xx	198,230	xx	184,337
Total (3	xx	xx	2,877,326	xx	3,165,938

(1 Excludes certain kinds of clays for 1992; kind and value included with "Combined value" data.

(2 Recoverable content of ores, etc.

(3 Quantity and value for 1991 are revised.

(4 Quantity and value for 1991 are estimates.

(5 Quantity and value for 1992 are estimates.

Source: "The Mineral Industry of Arizona in 1992," U.S. Bureau of Mines.

Table 8. Stripping ratios of open pit mines

[Waste:ore. Leachable rock included with waste at some mines. Leaders (--), no data]

Company/Mine	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Arimetco International Inc.										
Emerald Isle	--	--	--	--	--	--	--	--	--	0.67:1
Johnson (1	0.03:1	--	--	--	--	--	--	--	--	1.16:1
Asarco Inc.										
Eisenhower (2 (3	0.57:1	1.26:1	--	--	--	--	--	--	--	--
Mission (3	2.52:1	1.32:1	0.74:1	0.84:1	1.05:1	2.02:1	1.41:1	2.87:1	3.92:1	2.53:1
Ray (4	2.72:1	2.11:1	2.27:1	2.12:1	1.99:1	2.10:1	1.70:1	1.90:1	3.18:1	2.40:1
Sacaton	0.35:1	0.10:1	--	--	--	--	--	--	--	--
San Xavier (3	0.96:1	1.97:1	(5	(5	(5	(5	6.72:1	6.05:1	1.82:1	1.12:1
Silver Bell	1.09:1	1.17:1	--	--	--	--	--	--	--	--
Cyprus Copper Co.										
Bagdad	1.53:1	0.94:1	0.42:1	0.54:1	0.77:1	1.96:1	1.23:1	1.17:1	0.80:1	0.80:1
Miami (6	0.27:1	1.72:1	1.50:1	1.82:1	2.04:1	2.01:1	0.96:1	0.55:1	0.57:1	0.83:1
Sierrita (7	0.33:1	0.76:1	0.55:1	0.19:1	0.40:1	0.67:1	0.77:1	0.79:1	0.91:1	0.92:1
Twin Buttes (8	1.14:1	--	--	--	--	34.60:1	8.37:1	4.38:1	2.15:1	0.73:1
Magma Copper Co.										
San Manuel	--	--	--	1.70:1	2.46:1	2.32:1	2.45:1	1.80:1	1.20:1	1.21:1
Pinto Valley	--	0.79:1	1.01:1	1.21:1	1.32:1	1.39:1	1.53:1	1.27:1	1.46:1	1.30:1
Phelps Dodge Corp.										
Morenci/Metcalf	0.64:1	0.90:1	0.68:1	0.76:1	1.10:1	1.13:1	1.22:1	1.81:1	1.78:1	1.86:1
New Cornelia	0.30:1	0.58:1	--	--	--	--	--	--	--	--
Weighted average	0.57:1	1.10:1	0.88:1	0.96:1	1.21:1	1.49:1	1.46:1	1.57:1	1.49:1	1.26:1

(1 Acquired from Cyprus, August, 1989.

(2 Mining was done by Asarco, includes ANAMAX's share of ore.

(3 Combined as Mission Complex in 1985.

(4 Acquired from Kennecott, November 18, 1986.

(5 Data for San Xavier included with Mission.

(6 Acquired from Inspiration, July 1, 1988.

(7 Sierrita and Esperanza acquired from Duval, April 1, 1986.

(8 Leased by Cyprus, March, 1988.

Source: "Minerals Yearbook - Area Reports: Domestic," U.S. Bureau of Mines; companies' annual reports; "E&MJ International Directory of Mining and Mineral Processing Operations;" Arizona Department of Mines and Mineral Resources; company submitted data beginning in 1985.

Table 9. Production and value of copper, molybdenum, gold, and silver recovered from copper ore

Year	Copper ore (tons)	Copper (1 (lb./ton ore) (cents/lb.)	Copper (1 (pounds) Value (2 (\$)	Molybdenum (1,000 lbs.) Value (\$1000)	Gold (troy ounces) Value (3 (\$)	Silver (troy ounces) Value (4 (\$)	Value of copper, gold, silver, and molybdenum (\$)
1972	165,914,825	10.22 50.617	1,695,858,000 858,392,446	27,126 46,791	102,526 5,987,518	6,614,957 11,143,226	922,314,190
1973	181,311,945	9.57 58.865	1,735,012,000 1,021,314,814	37,657 59,372	102,376 10,013,397	7,164,988 18,325,173	1,109,025,384
1974	178,913,296	9.00 76.649	1,609,808,000 1,233,901,735	28,346 57,067	90,206 14,488,424	6,308,721 29,701,332	1,335,158,491
1975	168,750,152	8.91 63.535	1,502,978,000 954,917,072	25,030 61,411	82,759 13,364,751	6,190,805 27,354,196	1,057,047,019
1976	194,136,559	9.85 68.824	1,912,430,000 1,316,210,823	31,073 89,148	97,961 12,276,473	7,308,395 31,816,805	1,449,452,101
1977	168,641,401	10.11 65.808	1,705,240,000 1,122,184,339	34,574 120,497	87,874 13,032,593	6,696,415 30,957,660	1,166,295,089
1978	178,204,491	10.20 65.510	1,817,670,000 1,190,755,617	33,029 150,142	92,508 17,905,108	6,611,781 35,709,502	1,244,520,369
1979	203,977,408	9.39 92.334	1,914,501,095 1,767,735,441	35,101 213,065	99,549 30,622,766	7,454,306 82,699,941	2,094,081,895
1980	169,650,401	8.97 101.416	1,521,850,812 1,543,400,219	36,299 324,150	71,533 43,814,606	5,640,703 116,376,559	2,027,741,384
1981	216,787,430	9.89 83.744	2,143,898,000 1,795,385,941	35,600 273,052	95,496 43,891,299	7,565,368 79,575,340	2,191,904,580
1982	146,124,870	11.62 74.31	1,697,500,000 1,261,415,000	22,099 100,673	61,050 22,949,000	6,301,000 50,090,000	1,435,127,000
1983	152,902,150	9.78 76.53	1,495,208,000 1,144,285,000	23,934 79,459	61,991 26,284,000	4,492,000 51,383,000	1,301,411,000
1984	145,278,431	10.89 66.00	1,582,549,000 1,044,483,000	23,184 78,827	51,548 18,591,200	4,093,000 33,320,000	1,175,151,000
1985	159,547,970	11.14 65.60	1,778,334,456 1,166,571,000	30,428 98,827	52,053 16,585,000	4,885,000 30,007,000	1,311,990,000
1986	153,439,000	11.42 66.05	1,752,525,000 1,157,543,000	29,382 75,607	63,334 23,370,000	4,202,000 22,987,000	1,279,507,000
1987	166,113,000	10.38 79.52	1,724,068,000 1,370,924,000	15,939 51,802	48,430 21,694,000	3,530,000 24,745,000	1,469,165,000
1988	175,261,000	10.76 119.00	1,885,112,000 2,243,283,000	29,132 78,074	60,981 26,972,000	4,766,000 31,157,000	2,379,486,000

Table 9. Production and value of copper, molybdenum, gold, and silver recovered from copper ore — continued

Year	Copper ore (tons)	Copper (1 (lb./ton ore) (cents/lb.)(2	Copper (1 (pounds) Value (2 (\$)	Molybdenum (1,000 lbs.) Value (\$1000)	Gold (troy ounces) Value (3 (\$)	Silver (troy ounces) Value (4 (\$)	Value of copper, gold, silver, and molybdenum (\$)
1989	196,684,000	10.22 129.01	2,009,782,000 2,592,723,000	29,795 99,545	44,959 17,283,000	5,312,000 29,367,000	2,738,918,000
1990	213,168,000	10.20 121.80	2,174,574,000 2,648,631,000	29,334 82,429	36,041 13,842,000	5,272,184 26,809,000	2,771,711,000
1991 (5)	258,646,597	8.76 107.93	2,265,071,603 2,444,692,000	35,051 82,370	51,248 18,554,000	4,735,187 19,126,000	2,564,742,000
1992	291,295,132	8.73 106.03	2,542,932,836 2,696,272,000	30,770 67,017	60,089 20,655,000	5,015,702 19,743,000	2,803,687,000

(1 Excludes precipitate copper from dump and in-place leaching prior to 1982.

(2 E&MJ average annual price, U.S. producer cathode for 1972-88. Metals Week annual average price, U.S. producer refiner for 1989 - 1992.

(3 Handy and Harmon average annual gold price.

(4 E&MJ average annual N.Y. market price for .999 fine silver for 1972-88. Metals Week's Handy and Harmon annual average quotation for 1989-1992.

(5 1991 Silver and Total values are revised.

Source: Table 1, this publication; "State Mineral Summaries," U.S. Bureau of Mines.

