

M O L Y B D E N U M

STATISTICS FOR 1972

ARIZONA, THE UNITED STATES AND THE WORLD

ARIZONA DEPARTMENT OF MINERAL RESOURCES

Fairgrounds

Phoenix, Arizona

**JOHN H. JETT,
Director**

**KEN A. PHILLIPS,
Mineral Resources Specialist**

DECEMBER, 1973

BOARD OF GOVERNORS

William T. Elsing, Phoenix - Chairman
(term expires January 31, 1976)

Ronald F. Teissere, Kingman
(term expires January 31, 1978)

Robert C. Bogart, Bagdad
(term expires January 31, 1974)

Robert H. Heineman, Tucson
(term expires January 31, 1975)

Walter Heinrichs, Jr., Tucson
(term expires January 31, 1977)

Arizona Molybdenum

Molybdenum is a unique mineral commodity in Arizona. Molybdenum production in Arizona is entirely a byproduct of copper production, so without the copper production there would be no molybdenum production. Therefore, the price of molybdenum, at this time, has little effect on its production in Arizona.

Arizona's 1972 production of molybdenum was 27,216,000 pounds contained in concentrates and was 20% greater than her 1971 production of 22,684,000 pounds, and 24.3% of the U.S. total of 112,138,000 pounds. The value of the 1972 production was \$46,791,000 and ranked second to copper in value. Molybdenum accounted for 4.3% of the total value of Arizona's 1972 mineral production.

In 1972, 0.0149 pounds of molybdenum were reported per pound of recoverable copper, up from 0.0139 pounds per pound of copper in 1971. This increase in molybdenum production per pound of copper reflects both the recovery of molybdenum from copper ores higher in molybdenum and increases in production from some molybdenum producing properties (mainly Duval Sierrita's).

Nearly all of Arizona's large copper mines produce byproduct molybdenum, the exception being those properties operated by Phelps Dodge. One mine, Duval Sierrita's Sierrita Mine, produced 42.9% of Arizona's molybdenum in 1972. Molybdenum accounted for over 20% of the value of production from this mine. Kennecott's molybdenum recovery plant at Ray Mines division was shut down through most of 1972 due to low molybdenum prices. Molybdenum production for the large Arizona copper mines, which account for all of the molybdenum produced in the state, is shown in Table XIV of the preceeding Arizona copper section or is attached if this report was obtained separately of the copper report.

M O L Y B D E N U M
PHYSICAL PROPERTIES 1/

"Molybdenum. A silvery-white, very hard, metallic element in the chromium group or group VI of the periodic system. Its physical properties are similar to those of iron and its chemical properties are similar to those of a nonmetal. Used for electrodes of mercury-vapor lamps, as wire for winding electric-resistance furnaces, and in steel alloys. Symbol, Mo; isometric; valences, 2, 3, 4?, 5?, and 6; atomic number, 42; atomic weight 95.94; specific gravity, 10.22 (at 20°C); melting point, $2,620^{\circ} \pm 10^{\circ}\text{C}$; boiling point, $5,560^{\circ}\text{C}$ or sublimes at $4,507^{\circ}\text{C}$ (at 760mm); insoluble in water, in hydrofluoric acid, and in ammonia; soluble in hot concentrated nitric acid, in hot concentrated sulfuric acid, and in aqua regia; and slightly soluble in hydrochloric acid. As an alloying agent, it increases the hardenability and toughness of quenched and tempered steels and it raises the strength of steel at high temperatures. Used in nickel-based alloys that are heat-resistant and corrosion-resistant; in electrodes in electrically heated glass furnaces and fore-hearths; in nuclear-energy applications; for missile and aircraft parts; and as a wire for filaments for metal-evaporation processes and for filaments, grids, and screens in electronic tubes.

(C.T.D.; Handbook of Chemistry and Physics, 45th ed., 1964, pp B2, B-121, B-195)."

1/ U. S. Bureau of Mines; A Dictionary of Mining, Mineral and Related Terms, p 723, (1968).

Molybdenum - TABLE I
MOLYBDENUM PRODUCTION
Molybdenum (content of concentrate)

<u>Year</u>	<u>U.S. 1/ lbs.</u> Thousands	<u>Arizona 2/ lbs.</u> Thousands	<u>Arizona's % of U.S.</u> Thousands	<u>Value of Arizona's Production 2/ Thousands</u>
1955	61,781	1,497	2.4	\$ 1,511
56	57,462	2,392	4.2	2,670
57	60,753	2,385	3.9	3,071
58	41,069	2,320	5.6	2,827
59	50,956	3,181	6.2	4,019
1960	68,237	4,359	6.4	5,211
61	66,563	4,878	7.3	6,232
62	51,244	4,412	8.6	5,864
63	65,011	5,553	8.5	7,584
64	65,605	6,296	9.6	9,532
1965	77,372	9,399	12.1	15,880
66	90,532	10,161	11.2	17,812
67	90,097	9,261	10.3	15,385
68	93,477	12,127	13.0	19,207
69	99,807	12,699	12.7	20,947
1970	111,352	15,672	14.0	26,700
71	109,592	22,684	20.7	39,872
72	112,138	27,216	24.3	46,791

Source: U.S. Bureau of Mines.

1/ Mine production.

2/ Production as measured by "Mine shipments." U.S. production so measured in thousands of pounds was: 1968 - 93,245; 1969 - 103,009; 1970 - 110,381; 1971 - 97,882; 1972 - 102,197; and for the five years averaged 3.7 percent lower than "Mine production."

Molybdenum - TABLE II
SALIENT MOLYBDENUM STATISTICS 1/

Molybdenum content, thousands of pounds and thousands of dollars							
	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>
UNITED STATES:							
Moly. Concentrate:							
Production	90,532	90,097	93,447	99,807	111,352	109,592	112,132
Shipments <u>2/</u>	91,670	81,596	93,245	103,009	110,381	97,882	102,197
Value	\$144,327	\$133,604	\$151,000	\$173,819	\$190,077	\$164,917	\$170,580
Consumption	75,476	58,967	75,647	73,275	76,101	66,399	62,560
Imports for Consumption	5	1,179	1	-	25	854	385
Stocks, End of period:							
At Mines and Plants <u>3/</u>	3,433	9,919	12,208	8,398	9,715	29,077	45,243
Primary Moly. Products:							
Production <u>4/</u>	74,392	54,922	69,675	68,526	r/ 75,383	67,016	64,841
Shipments <u>2/</u>	78,811	57,231	63,761	77,726	76,095	66,654	75,538
Consumption	52,324	49,506	49,271	51,622	45,337	40,950	45,538
Producers Stocks:							
End of period	5,945	7,156	18,170	17,844	25,904	31,048	28,899
FREE WORLD:							
Production <u>5/</u>	124,988	126,273	128,071	142,639	r/181,429	170,840	175,250
Consumption <u>6/</u>	111,000	112,000	123,000	132,000	135,000	131,000	144,000

r/ Revised

1/ Sources: U.S. Bureau of Mines. Mining, Annual Review. 2/ Including exports. 3/ Producing molybdenum products. 4/ Comprises total production of all products less quantities of oxide, etc. used to produce other products. 5/ Molybdenum in ores and concentrates. See Table VI. 6/ Molybdenum in concentrates. Estimates in molybdenum chapters of "Mining, Annual Review," issues relating to the above years.

Molybdenum - TABLE III
Consumption of molybdenum materials by end uses in 1972
(Thousand pounds, contained molybdenum)

End use	Molybdic oxides	Ferro- molyb- denum <u>1/</u>	Ammonium and sodium Molybdate	Other molybdenum materials <u>2/</u>	Total <u>3/</u>
Steel:					
Carbon	1,024	201	-	11	1,236
Stainless and heat resisting	4,111	1,688	-	63	5,862
Full alloy	15,284	1,529	-	107	16,920
High-strength low- alloy	2,466	481	-	7	2,954
Electric	907	89	-	-	996
Tool	2,097	974	-	31	3,102
Cast irons	734	2,764	-	180	3,678
Superalloys	770	323	-	1,283	2,376
Alloys (exclude steels and superalloys):					
Welding and alloy hard-facing rods and materials	-	317	-	18	335
Other alloys <u>4/</u>	70	486	-	169	725
Mill products made from metal powder	-	-	-	2,467	2,467
Chemical and ceramic uses:					
Pigments	657	-	439	22	1,118
Catalysts	1,442	-	W	-	1,442
Other	412	-	22	786	1,220
Miscellaneous and unspecified	189	125	425	388	1,127
Total <u>3/</u>	30,163	8,977	886	5,532	45,558
Consumer stocks December 31, 1972	2,194	1,586	116	1,000	4,896

W Withheld to avoid disclosing individual company confidential data, included in "Miscellaneous and unspecified." 1/ Includes calcium molybdate. 2/ Includes purified molybdenum disulfide, molybdenite concentrates added directly to steel, molybdenum metal powder, molybdenum metal pellets and other molybdenum materials. 3/ Data may not add to totals shown because of independent rounding. 4/ Includes magnetic and nonferrous alloys.

Source: U.S. Bureau of Mines.

Molybdenum - TABLE IV
FREE WORLD PRODUCTION OF MOLYBDENUM IN
ORES AND CONCENTRATES

Thousands of pounds contained molybdenum

Country	1970	1971	1972 <u>p/</u>
Australia	130	<u>e/</u> 130	<u>e/</u> 130
Canada (shipments)	33,772	22,663	24,844
Chile	<u>r/</u> 12,569	13,935	13,045
China, Peoples Republic of <u>e/</u>	3,300	3,300	3,300
Japan	<u>r/</u> 582	613	825
Korea, Republic of (South)	254	231	110
Mexico	311	174	172
Norway	<u>r/</u> 750	811	<u>e/</u> 880
Peru	1,338	1,782	1,712
Philippines	71	9	-
U.S.S.R. <u>e/</u>	17,000	17,600	18,100
United States	111,352	109,592	112,132
Total	181,429	170,840	175,250

e/ Estimate p/ Preliminary r/ Revised

1/ In addition to the countries listed, Argentina, North Korea, Nigeria, Romania, South-West Africa and Spain also may produce molybdenum, but information is inadequate to make reliable estimates of output levels.

Source: U.S. Bureau of Mines.

TABLE XIV COPPER AND MOLYBDENUM PRODUCTION OF LARGE ARIZONA COPPER MINES

Company Mine	1971			1972		
	Tons Copper Ore Mined	Pounds Recoverable Copper	Pounds Recoverable Molybdenum	Tons Copper Ore Mined	Pounds Recoverable Copper	Pounds Recoverable Molybdenum
ANACONDA:						
Twin Buttes	7,676,640	106,661,096	1,208,000	10,137,624	155,719,980	2,119,249
ASARCO:						
Silver Bell	3,796,000	38,692,504		3,839,600	39,223,598	128,582
Precipitate Copper	-	6,296,544			7,897,007	-
Mission	6,724,900	79,048,691		8,363,800	90,742,767	1,902,029
San Xavier - Si. flux	68,159	1,046,293		75,580	1,229,772	-
Total	10,589,059	125,084,032	1,659,000 2/	12,278,980	139,093,144	2,030,611
BAGDAD:						
Bagdad	2,000,974	25,039,418		1,982,368	24,558,652	455,380
Precipitate Copper		-			-	
Cathode Copper		14,680,540			13,390,668	
Total	2,000,974	39,719,958	459,000	1,982,368	37,949,320	455,380
CITIES SERVICE -						
MIAMI COPPER OPERATIONS:						
Copper Cities	4,629,571	44,858,816		5,052,617	42,501,763	213,926
Copper Cities Precipitate		4,375,751			4,577,066	
Miami - Precipitate		12,806,085			12,170,335	
Castle Dome - Precipitate		-			-	
Total	4,629,571	62,040,652	208,000	5,052,617	59,249,164	213,926
DUVAL:						
Esperanza	5,280,200	36,958,100			194,795	
Precipitate Copper		4,454,106			2,094,329	
Mineral Park	5,645,080	43,495,519		6,975,594	44,181,863	3,503,237
Precipitate Copper		7,315,234			8,935,811	-
Sierrita	25,727,175	126,098,171	9,846,000	28,304,333	137,880,330	11,677,246
Total	36,652,455	218,321,130	11,798,000 2/	35,279,927	193,287,128	15,180,483
INSPIRATION:						
Inspiration	6,862,253	74,229,548		7,792,285	87,407,628	28,138
Copper recovered by dump, in-place and vat leaching	-	16,332,654			20,587,885	
Christmas Division	1,537,883	13,652,047		1,850,122	22,488,926	
Ox Hide Mine	2,630,267	7,962,311		2,400,230	9,672,768	
Total	11,030,403	112,176,560	229,968	12,042,637	140,157,207	28,138

(continued next page)

TABLE XIV COPPER AND MOLYBDENUM PRODUCTION OF LARGE ARIZONA COPPER MINES (continued)

Company Mine	1971			1972		
	Tons Copper Ore Mined	Pounds Recoverable Copper	Pounds Recoverable Molybdenum	Tons Copper Ore Mined	Pounds Recoverable Copper	Pounds Recoverable Molybdenum
<u>KENNECOTT:</u>						
Ray	10,277,916	126,856,249		10,364,150	122,736,684	31,538
Precipitate Copper		31,622,099			31,472,083	
Total	<u>10,277,916</u>	<u>158,478,348</u>	<u>13,353,000 2/</u>	<u>10,364,150</u>	<u>154,208,767</u>	<u>31,538</u>
<u>MAGMA:</u>						
San Manuel	14,975,910	166,656,905		21,844,943	271,501,061	4,953,567
Superior	427,681	35,608,542		450,573	36,337,188	
Total	<u>15,403,591</u>	<u>202,265,447</u>	<u>3,165,000</u>	<u>22,295,516</u>	<u>307,838,249</u>	<u>4,953,567</u>
<u>PHELPS DODGE:</u>						
Morenci	16,589,805	213,008,679		17,214,592	215,031,874	
Precipitate Copper		14,188,039			24,492,649	
New Cornelia	9,243,860	105,995,691		9,792,178	115,749,958	
Lavender Pit	4,574,609	39,689,498		3,760,691	33,263,583	
Precipitate Copper		8,344,567			9,999,890	
Copper Queen	768,389	58,005,882		643,385	53,798,695	
Precipitate Copper		1/			1/	
Total	<u>31,176,663</u>	<u>439,232,356</u>		<u>31,410,846</u>	<u>452,336,649</u>	
<u>PIMA MINING:</u>						
Pima	14,616,949	136,145,699	1,429,000	18,698,023	165,682,532	1,158,513
Total - Large Co's	<u>144,054,221</u>	<u>1,600,125,278</u>	<u>22,684,000 5/</u>	<u>159,542,688</u>	<u>1,805,522,140</u>	<u>26,171,405 7/</u>
Other Copper Ores 4/	<u>5,239,779</u>	<u>33,442,722</u>	<u>-0-</u>	<u>6,373,137</u>	<u>11,701,860</u>	<u>-0- 7/</u>
GRAND TOTAL 3/	<u>149,294,000</u>	<u>1,633,568,000</u>	<u>22,684,000</u>	<u>165,915,825</u>	<u>1,817,224,000</u>	<u>27,216,000 7/</u>
				<u>6/</u>		

Source: Company Reports.

1/ Included with Lavender Pit precipitate copper.

2/ Includes molybdenum produced by company from operations outside Arizona.

3/ U.S. Bureau of Mines data - used to compute those for "Other Copper Ores."

4/ Determined by difference.

5/ U.S. Bureau of Mines data. Detail will not add to total. See data footnoted 2/ and 3/.

6/ Includes some copper-zinc and lead-zinc ore in addition to copper ore, all of which is combined to avoid disclosing individual company confidential data.

7/ Arizona's entire molybdenum production is a product of the large copper mines. Differences in values are due to time and methods of reporting.