



# 2013 Minerals Yearbook

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**MOLYBDENUM [ADVANCE RELEASE]**

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# MOLYBDENUM

By Désirée E. Polyak

**Domestic survey data and tables were prepared by Raymond I. Eldridge III, statistical assistant, and the world production table was prepared by Lisa D. Miller, international data coordinator.**

In the United States, mine production of molybdenum concentrate in 2013 decreased slightly to 60,700 metric tons (t) from the revised 61,500 t in 2012. Primary molybdenum production continued at three U.S. operations accounting for 53% of total U.S. molybdenum production. Byproduct molybdenum production continued at eight U.S. operations accounting for 47% of total U.S. molybdenum production. World mine production of molybdenum was estimated at 258,000 t in both 2012 and 2013 (table 1). The U.S. share of world production was 24% in 2013. Reported U.S. consumption of primary molybdenum products, not including molybdenum concentrates, decreased by 4% in 2013 compared with that of 2012 (table 3).

Molybdenum is a refractory metallic element used principally as an alloying agent in cast iron, steel, and superalloys to enhance hardenability, strength, toughness, and wear- and corrosion-resistance. To achieve desired metallurgical properties, molybdenum, primarily in the form of molybdic oxide ( $\text{MoO}_3$ , called MoX) or ferromolybdenum (FeMo), is commonly used in combination with or added to chromium, manganese, nickel, niobium (columbium), tungsten, or other alloy metals. The versatility of molybdenum in enhancing a variety of alloy properties has ensured it a significant role in contemporary industrial technology, which increasingly requires materials that can sustain high stress, expanded temperature ranges, and highly corrosive environments. Significant uses of molybdenum are as a refractory metal and in numerous chemical applications, including catalysts, lubricants, and pigments. Molybdenum has become increasingly more important in green technology, particularly in biofuels, catalysts, ethanol, solar panels, and wind power.

U.S. molybdenum reserves were estimated to be about 2.7 million metric tons (Mt), about 31% of world molybdenum reserves. About 90% of U.S. reserves occur in large, low-grade porphyry molybdenum deposits mined or anticipated to be mined primarily for molybdenum and in low-grade porphyry copper deposits as an associated metal sulfide. These deposits are in Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, and Utah. Other molybdenum sources do not contribute significantly to U.S. reserves.

## Production

Domestic molybdenum mine production data were derived from three separate voluntary surveys by the U.S. Geological Survey. These surveys are “Molybdenum Ore and Concentrate” (annual), “Molybdenum Concentrate” (monthly), and “Molybdenum Products and Molybdenum Concentrates” (monthly). Surveys were sent to all 11 U.S. operations that currently produce molybdenum concentrates and products from

ore, and all responded, representing 100% of U.S. production listed in table 1.

As of December 31, 2013, U.S. rated capacity for mines and mills was estimated to be about 98,900 metric tons per year (t/yr) of contained metal. Rated capacity is defined as the maximum quantity of product that can be produced in a period of time on a normally sustainable long-term operating rate, based on the physical equipment of the plant and given acceptable routine operating procedures involving energy, labor, maintenance, and materials. Capacity included plants that were temporarily closed but could be brought into production within a short period of time with minimal capital expenditure.

Primary molybdenum production continued at the Henderson Mine in Colorado and the Thompson Creek Mine in Idaho. Molybdenum production ceased at the Ashdown Mine in Nevada and the Questa Mine in New Mexico. Freeport-McMoRan Copper & Gold Inc. (FCX) announced that its Climax Mine produced 8,620 t of molybdenum in 2013 compared with 3,180 t of molybdenum produced in 2012. The Climax open pit mine was commissioned in the second quarter of 2012 and included a 25,000-metric-ton-per-day (t/d) mill facility (Freeport-McMoRan Copper & Gold Inc., 2014a, p. 52). The Henderson Mine produced 13,600 t of molybdenum in 2013 compared with 15,400 t of molybdenum produced in 2012 (Freeport-McMoRan Copper & Gold Inc., 2014b, p. 13). The Climax and Henderson Mines produced high-purity, chemical-grade molybdenum concentrates, which typically are further processed into value-added molybdenum chemical products. The Henderson operation consisted of a large underground mining complex that feeds a 32,000-t/d concentrator. Henderson had the capacity to produce 18,140 t/yr of molybdenum (Freeport-McMoRan Copper & Gold Inc., 2014b, p. 13). The majority of the molybdenum concentrate produced at Henderson was shipped to FCX’s Fort Madison, IA, processing facility.

Thompson Creek Metals Co. Inc. (TCMC) owned the Thompson Creek open pit molybdenum mine and mill near Challis, ID; a metallurgical roasting facility in Langeloth, PA; and a 75% joint-venture interest in the Endako open pit mine, mill, and roasting facility in northern British Columbia, Canada. The molybdenum concentrate produced at the Thompson Creek Mine was transported to the Langeloth facility, which produced ferromolybdenum products, molybdenum trioxide, and other specialty products. The Langeloth facility also processed nonmolybdenum catalysts for various customers, primarily in the food industry. TCMC had two high-grade underground molybdenum deposits—the Davidson deposit near Smithers, British Columbia, Canada, and the Mount Emmons deposit near Crested Butte, CO (Thompson Creek Metals Co. Inc., 2013, p. 11).

TCMC announced that its Thompson Creek Mine produced 9,480 t of molybdenum in 2013, a 29% increase from 7,370 t of molybdenum produced in 2012 (Thompson Creek Metals Co. Inc., 2014, p. 1). According to the company, primary improvement in production was the result of the planned mine pit sequencing and transitioning into Phase 7 of production in the second half of 2012 (Thompson Creek Metals Co. Inc., 2013, p. 43). In October 2012, owing to continued decreases in molybdenum prices, TCMC suspended waste stripping activity associated with Phase 8. In December 2013, TCMC announced that it would put the Thompson Creek Mine on care-and-maintenance status when mining of Phase 7 was completed, which was expected to be in the fourth quarter of 2014 (Thompson Creek Metals Co. Inc., 2013, p. 11).

Molybdenum was produced as a byproduct of copper production at the Bagdad, Mineral Park, Morenci, and Sierrita Mines in Arizona; the Continental Pit Mine in Montana; the Robinson Mine in Nevada; the Chino Mine in New Mexico; and the Bingham Canyon Mine in Utah (table 2). The Mission and Pinto Valley Mines in Arizona did not produce molybdenum in 2012 or 2013. In the case of byproduct molybdenum recovery at a copper mine, all mining costs associated with molybdenum concentrate production are allocated to the primary metal (copper). In 2013, byproduct molybdenite recovery accounted for approximately 47% of the U.S. molybdenum supply.

The Bagdad operation of FCX included a 75,000-t/d concentrator that produced copper and molybdenum concentrates, as well as a pressure-leach plant that processed molybdenum concentrate. Bagdad produced approximately 3,630 t of molybdenum in 2013, a 20% decrease compared with 4,540 t produced in 2012 (Freeport-McMoRan Copper & Gold Inc., 2014b, p. 9).

The Morenci operation of FCX included a 50,000-t/d concentrator that produced copper and molybdenum concentrates. Morenci produced approximately 910 t of molybdenum in 2013, a 33% decrease compared with 1,360 t of molybdenum produced in 2012 (Freeport-McMoRan Copper & Gold Inc., 2014b, p. 8).

The Sierrita operation of FCX included a 102,000-t/d concentrator that produced copper and molybdenum concentrates. It also had molybdenum facilities consisting of a leaching circuit, two molybdenum roasters, and a packaging facility. The molybdenum facilities processed concentrate from Sierrita, other FCX mines, and third-party sources. Molybdenum production at Sierrita in 2013 was 9,070 t, a 6% decrease compared with 9,600 t of molybdenum produced in 2012 (Freeport-McMoRan Copper & Gold Inc., 2014b, p. 10).

FCX's Chino Mine is an open pit copper-mining complex located in southwestern New Mexico's Grant County. The Chino operation consisted of a 39,000-t/d concentrator that produced copper and molybdenum concentrates. During 2011, FCX restarted mining and milling activities at the Chino Mine, which were suspended in late 2008. Chino produced approximately 910 t of molybdenum in 2013 (Freeport-McMoRan Copper & Gold Inc., 2014b, p. 12).

Rio Tinto plc (London, United Kingdom) reported that molybdenum concentrate production at its Bingham Canyon Mine (operated by Kennecott Utah Copper Corp.) was 5,700 t

in 2013, compared with 9,400 t in 2012 (Rio Tinto plc, 2014, p. 213). In April, the Bingham Canyon Mine experienced a 165 Mt landslide on the northeast wall. The 39% decrease in molybdenum production in 2013 was partially attributed to the landslide. The company anticipated operations to be back to normal in 2016 (Rio Tinto plc, 2014, p. 28).

In September 2013, General Moly Inc. (Lakewood, CO) announced it was fully permitted, construction-ready, and actively pursuing full financing options for the Mt. Hope molybdenum project in Eureka County, NV. The company announced that construction would take approximately 2 years after being fully funded, and at full production the mine would have the capacity to produce approximately 18,000 t/yr of molybdenum (General Moly Inc., 2013).

Mercator Minerals Ltd. announced that it produced 4,300 t of molybdenum in 2013, a 9% decrease from 4,700 t of molybdenum produced in 2012. The Mineral Park Mine is located in northwestern Arizona, 120 kilometers (km) from Las Vegas, NV (Mercator Minerals Ltd., 2014).

## Consumption

In 2013, U.S. reported consumption of molybdenum contained in concentrate for roasting increased compared with that of 2012. Domestic mine production of molybdenum concentrate was roasted, exported for conversion, or purified to lubricant-grade molybdenum disulfide ( $\text{MoS}_2$ ).  $\text{MoX}$  was the leading form of molybdenum used by industry, particularly in making stainless steel. Superalloy industry consumption decreased by 8% in 2013 from that of 2012. Overall, total molybdenum use in steel in 2013 decreased 11% from that of 2012 (table 3).

Metallurgical applications dominated molybdenum use in 2013, accounting for about 87% of 2013 grand total reported consumption. In 2013, FeMo accounted for 39% of the molybdenum-bearing materials used to make steel (not including tool steel) (table 3). Nonmetallurgical applications included catalysts, chemicals, lubricants, and pigments. The dominant nonmetallurgical use was in catalysts, principally catalysts related to petroleum refining.

According to the International Molybdenum Association (IMOA), molybdenum compounds continued to play an important role in sustainable and environmentally safe pigments. Greater awareness of toxicity and environmental impact was generating a push to replace older, sometimes toxic, pigments. A new class of complex, inorganic, high-performance color pigments was created from oxides containing two or more metals. These complex oxides used chromium, cobalt, copper, iron, manganese, nickel, and vanadium to form their basic oxide structure and color. Adding molybdenum modified the color of the pigment. These pigments were some of the most stable and durable type of colorants commercially available. The worldwide annual market in 2013 for all pigments was about 8 Mt with a value of nearly \$20 billion. Molybdenum-containing pigments accounted for a small part of this market; however, they were expected to play an increasing role in environmentally friendly pigments in years to come (International Molybdenum Association, 2014b, p. 10).

## Stocks

At yearend 2013, producer plus consumer industry stocks increased compared with yearend 2012 stocks. Inventories of molybdenum in concentrate at mines and plants increased (table 1). Stocks of molybdenum in FeMo, molybdates, MoX, metal powders, and other products increased compared with stocks of 2012 (table 3).

## Prices

In 2013, the annual average price for domestic FeMo, as published in Ryan's Notes, ranged from \$11.067 to \$12.838 per pound of molybdenum content, compared with \$14.582 to \$14.851 per pound reported in 2012. The Ryan's Notes annual average price for domestic MoX ranged from \$9.350 to \$11.810 per pound in 2013, compared with \$12.630 to \$12.854 per pound in 2012.

## Foreign Trade

In 2013, molybdenum-containing exports (excluding molybdenum ore and concentrates) collectively were about 5,370 t (gross weight) valued at \$159 million (table 6). Imports for consumption of all molybdenum-containing products collectively were about 35,000 t (gross weight) valued at \$514 million (table 9).

## World Review

World molybdenum reserves and production capacity were concentrated in a few countries. In 2013, world mine output was estimated to have been 258,000 t (molybdenum contained in concentrate), of which, in descending order of production, China, the United States, Chile, Peru, Mexico, and Canada provided about 92% (table 10).

Most reserves of molybdenum in Canada were contained in porphyry molybdenum and porphyry copper-molybdenum deposits in British Columbia. Other reserves in Canada were associated with minor porphyry copper-molybdenum deposits in New Brunswick and Quebec. The La Caridad porphyry copper-molybdenum deposit in Mexico was a leading producer. Molybdenum reserves in Central America and South America were associated mainly with large porphyry copper deposits. Of several such deposits in Chile, the Chuquicamata and El Teniente deposits were among the largest in the world and accounted for 85% of molybdenum reserves in Chile. Peru also had substantial reserves. Reserves of molybdenum in China and the Commonwealth of Independent States (CIS) were thought to be substantial, but definitive information about the current sources of supply or prospects for future development in these two areas is lacking.

According to the IMO, global molybdenum consumption was a record high of 243,900 t in 2013, compared with a 237,000 t in 2012. The leading consumer of molybdenum in 2013 continued to be China, where consumption increased to 89,000 t in 2013 from 85,500 t in 2012. Europe had the second largest share with 63,700 t in 2013, compared with 61,600 t in 2012 (International Molybdenum Association, 2014a).

**Canada.**—TCMC announced that its 75%-owned Endako Mine produced 4,110 t of molybdenum in 2013 compared with 2,810 t of molybdenum in 2012. The Endako operation was an open pit molybdenum mine, concentrator, and roaster, 190 km west of Prince George, British Columbia, with an estimated mine life of 16 years (Thompson Creek Metals Co. Inc., 2014).

At its Gibraltar Mine in south-central British Columbia, Taseko Mines Ltd. produced 680 t of molybdenum in 2013, a 14% increase from the 598 t of molybdenum produced in 2012. The new molybdenum separation facility, which was commissioned in mid-2013, was still in ramp up but significant strides were made in the fourth quarter (Taseko Mines Ltd., 2014).

**Chile.**—Amerigo Resources Ltd. produced 366 t of molybdenum in 2013, compared with 479 t in 2012, at its Minera Valle Central plant. Amerigo processed tailings from El Teniente's Colihues tailings pond as well as fresh tailings from the mine's concentrator. The plant extracted copper from tailings discharged from CODELCO's El Teniente concentrators. The tailings were then returned to El Teniente's tailings disposal system. In July 2013, Amerigo's contract was extended to process tailings until 2037, 16 years past its original contract expiration date of 2021. The new contract also gave the company the right to process old tailings from a second tailings pond facility called Cauquenes, into which tailings from the mine were poured from the 1930s until the 1970s. The new agreement was expected to double Amerigo's molybdenum production within approximately 2 years after starting the capacity expansion at its existing plant to accommodate the additional material (Amerigo Resources Ltd., 2013).

Antofagasta plc announced that 2013 molybdenum production at its Los Pelambres Mine was 9,000 t, a 26% decrease compared with 12,200 t of molybdenum produced in 2012. The company attributed the decrease to lower ore grades. Los Pelambres is in Chile's Coquimbo Region, 240 km northeast of Santiago (Metal-Pages, 2014e).

The Esperanza copper-gold project, situated in the Sierra Gorda district of Antofagasta, northern Chile, is jointly owned by Antofagasta and Marubeni Corp. The mine began production in November 2010. Production of molybdenum was expected to start in 2015, with approximately 2,000 t/yr of molybdenum produced for a total of 10 years (Metal-Pages, 2014e).

Corporación Nacional del Cobre de Chile (Codelco), the state-controlled copper and molybdenum producer, announced that it produced 23,000 t of molybdenum in 2013 compared with 20,000 t in 2012 (Metal-Pages, 2014d).

The Sierra Gorda project, in the Antofagasta region in northern Chile, was a joint venture between KGHM International Ltd., Sumitomo Metal Mining Co., Ltd., and Sumitomo Corp. In March of 2014, KGHM announced that it had completed a 142-km-long seawater pipeline for the project (Jamasmie, 2014). The open pit mine was still under construction and was expected to begin production in the second half of 2014. Estimated production from current reserves was approximately 11,300 t/yr of molybdenum (Sumitomo Corp., 2014).

**China.**—Yichun Luming Molybdenum Mining Co. Ltd. (a subsidiary of China Railway Resources Group) announced

that commercial production at its Luming molybdenum mine in Heilongjiang Province was expected to begin in July 2014. According to the company, the mine had a capacity to process 30,000 t/yr of molybdenum concentrate. Construction began in May 2011 (Metal-Pages, 2014c).

According to official customs data, China's exports of MoX decreased by 54% to 5,067 t in 2013, compared with those of 2012 (Metal-Pages, 2014a). China's total imports of MoX increased by 15% to 9,886 t in 2013, compared with those of 2012 (Metal-Pages, 2014b).

**Kazakhstan.**—Kazakhmys plc announced that the supporting infrastructure for the concentrator and mine at its Bozshakol project in northern Kazakhstan had undergone significant construction developments. Construction of the main concentrator building and other processing facilities was also progressing. Construction of the mine maintenance workshop and the truck shop was expected to be completed and pre-production mining was expected to commence in 2014. The capital cost for the project was approximately \$2.2 billion, funded from a \$2.7 billion financing facility provided by the China Development Bank and Samruk-Kazyna, the National Welfare Fund in Kazakhstan (Kazakhmys plc, 2014, p. 34).

**Mexico.**—Grupo Mexico S.A.B. de C.V. reported that its La Caridad Mine produced a record-high 11,740 t of molybdenum in 2013 compared with 10,968 t of molybdenum in 2012 (Grupo Mexico S.A.B. de C.V., 2014, p. 6). The company also announced that the new molybdenum processing plant at Grupo Mexico's Buenavista del Cobre Mine in Cananea, Sonora, produced 360 t of molybdenum in 2013. The plant had a capacity to produce 2,600 t/yr of molybdenum (Grupo Mexico S.A.B. de C.V., 2014, p. 8).

**Peru.**—The Cerro Verde Mine of FCX is an open pit copper and molybdenum mining complex, 16 km southwest of Arequipa. In 2013, the operation consisted of an open pit copper mine, a 120,000-t/d concentrator, and leaching facilities. Cerro Verde continued construction of its large-scale expansion project, which would expand its concentrator facilities from 120,000 t/d to 360,000 t/d of ore and would have the capacity to produce 6,800 t/yr of molybdenum beginning in 2016. In 2013, molybdenum production at Cerro Verde was approximately 5,900 t of molybdenum, a 63% increase compared with 3,630 t of molybdenum produced in 2012 (Freeport-McMoRan Copper & Gold Inc., 2014b, p. 14–15).

## Outlook

The principal uses for molybdenum are expected to continue to be in chemicals and catalysts and as an additive in steel manufacturing, most importantly alloy and stainless steel. Molybdenum plays a vital role in the energy industry, and it may become an increasingly important factor in environmental protection technology, where it is used in high-strength steels for automobiles to reduce weight and improve fuel economy and safety. Molybdenum-based catalysts have a number of important applications in the petroleum and plastics industries. A major use is in the hydrodesulfurization of petroleum, petrochemicals, and coal-derived liquids. Production of ultra-low-sulfur diesel fuels was expected to more than double the amount of molybdenum used in oil refineries. Molybdenum not only allows for

economical fuel refining, it also contributes to a safer environment through lower sulfur emissions. Analysts expect global demand for catalysts to increase by more than 5% annually until 2016, resulting in a market for new molybdenum of approximately 20,000 t/yr as there are no practical alternatives to molybdenum in many of its catalytic applications (Roskill Information Services Ltd., 2012, p. 305). The need for companies to reduce carbon dioxide emissions from coal-fired power stations will require plants to run at higher temperatures, resulting in greater demand for higher grade molybdenum-bearing steels.

During the past decade, molybdenum consumption has shown a strong annual average growth rate, primarily fueled by rapid increases in China's industrial growth. Molybdenum consumption continues to be heavily dependent on the steel industry. As emerging economies, such as China and India, continue on the path to industrialization, they are expected to need increasing amounts of molybdenum, and this trend is expected to contribute to global demand growth in the coming years (Virga and Horn, 2009). Roskill Information Services Ltd. (2012, p. 300) reported that global consumption for molybdenum is expected to increase at an annual average of 4.6% through 2016. The principal areas of molybdenum growth are expected to continue to be in the use of stainless and other steels containing molybdenum in aero engine components, chemical and petrochemical processing plants, power and desalination plants, motor vehicle components, nuclear powerplants, and in wind power generation components.

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TABLE 1  
SALIENT MOLYBDENUM STATISTICS<sup>1</sup>

(Metric tons of contained molybdenum)

	2009	2010	2011	2012	2013
United States:					
Concentrate:					
Production	47,800	59,400	63,700	61,500 <sup>r</sup>	60,700
Shipments	63,700	59,400	62,800	61,600 <sup>r</sup>	67,800
Reported consumption <sup>2</sup>	W	W	W	W	W
Imports for consumption	7,520	12,900	14,600	12,000	13,100
Stocks, December 31:					
Concentrate, mine and plant	2,550	2,200	3,520	W	W
Product producers <sup>3</sup>	3,660	W	W	W	W
Consumers	1,540	1,630	1,810	1,770 <sup>r</sup>	1,820
Total	7,750	3,820	5,330	1,770 <sup>r</sup>	1,820
Primary products:					
Production	59,900	68,600	W	W	W
Shipments	43,300	51,100	W	W	W
Reported consumption	17,700	19,200	19,100	19,400 <sup>r</sup>	18,600
Imports for consumption	3,870	6,780	6,450	7,830	7,190
World, mine production	221,000 <sup>r</sup>	245,000 <sup>r</sup>	265,000 <sup>r</sup>	258,000 <sup>r</sup>	258,000 <sup>e</sup>

<sup>e</sup>Estimated. <sup>r</sup>Revised. W Withheld to avoid disclosing company proprietary data.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Molybdenum concentrates roasted to make molybdenum oxide.

<sup>3</sup>Includes ammonium, calcium, and sodium molybdate; briquets; ferromolybdenum; molybdenum hexacarbonyl; molybdenum metal; molybdenum pentachloride; molybdic acid; pellets; phosphomolybdic disulfide; and technical and purified molybdic oxide.

TABLE 2  
MOLYBDENUM-PRODUCING MINES IN THE UNITED STATES IN 2013

State and mine	County	Operator	Source of molybdenum
Arizona:			
Bagdad	Yavapai	Freeport-McMoRan Copper & Gold Inc.	Copper-molybdenum ore, concentrated.
Mineral Park	Mohave	Mercator Minerals Ltd.	Do.
Morenci	Greenlee	Freeport-McMoRan Copper & Gold Inc.	Do.
Sierrita	Pima	do.	Do.
Colorado:			
Climax	Lake	do.	Molybdenum ore, concentrated.
Henderson	Clear Creek	do	Do.
Idaho, Thompson Creek	Custer	Thompson Creek Metals Co. Inc.	Do.
Montana, Continental Pit	Silver Bow	Montana Resources	Copper-molybdenum ore, concentrated.
Nevada, Robinson	White Pine	KGHM International Ltd.	Do.
New Mexico, Chino	Grant	Freeport-McMoRan Copper & Gold Inc.	Do.
Utah, Bingham Canyon	Salt Lake	Kennecott Utah Copper Corp. <sup>1</sup>	Do.

Do., do. Ditto.

<sup>1</sup>Wholly owned subsidiary of Rio Tinto plc.

TABLE 3  
U.S. REPORTED CONSUMPTION, BY END USES, AND CONSUMER STOCKS OF MOLYBDENUM MATERIALS<sup>1</sup>

(Kilograms of contained molybdenum)

End use	Molybdic oxides	Ferromolybdenum <sup>2</sup>	Ammonium and sodium molybdate	Molybdenum scrap	Other	Total
<b>2012:</b>						
<b>Steel:</b>						
Carbon	450,000	283,000	--	--	W	732,000
High-strength low-alloy	652,000	123,000	--	--	--	775,000
Stainless and heat-resisting	1,970,000	684,000	--	(3)	131,000	2,780,000
Full alloy	3,240,000	3,350,000	--	--	W	6,600,000
Tool	607,000	W	--	(3)	--	607,000
Total	6,920,000	4,440,000	--	--	131,000	11,500,000
Cast irons (gray, malleable, ductile iron)	W	345,000	--	--	W	345,000
Superalloys	700,000 <sup>†</sup>	W	--	(3)	1,370,000 <sup>†</sup>	2,070,000 <sup>†</sup>
<b>Alloys (other than steels, cast irons, superalloys):</b>						
Welding materials (structural and hard-facing)	--	41,500	--	--	W	41,500
Other alloys	2,130	92,500	--	--	W	94,600
Mill products made from metal powder <sup>4</sup>	W	--	--	--	W	W
Cemented carbides and related products <sup>5</sup>	--	--	--	--	77	77
<b>Chemical and ceramic uses:</b>						
Pigments	W	--	4,890	--	--	4,890
Catalysts	947,000 <sup>†</sup>	--	(3)	--	W	947,000 <sup>†</sup>
Other	--	--	--	--	W	W
<b>Miscellaneous and unspecified uses:</b>						
Lubricants	--	--	--	--	208,000	208,000
Other	44,600	89,200 <sup>†</sup>	(3)	--	4,100,000 <sup>†</sup>	4,240,000 <sup>†</sup>
Grand total	8,610,000 <sup>†</sup>	5,010,000 <sup>†</sup>	4,890	--	5,810,000 <sup>†</sup>	19,400,000 <sup>†</sup>
Stocks, December 31	541,000 <sup>†</sup>	331,000	4,200	(6)	(6)	1,770,000 <sup>†</sup>
<b>2013:</b>						
<b>Steel:</b>						
Carbon	454,000	173,000	--	--	W	628,000
High-strength low-alloy	W	112,000	--	--	--	112,000
Stainless and heat-resisting	2,020,000	680,000	--	(3)	131,000	2,830,000
Full alloy	3,260,000	2,790,000	--	--	W	6,050,000
Tool	607,000	W	--	(3)	--	607,000
Total	6,340,000	3,760,000	--	--	131,000	10,200,000
Cast irons (gray, malleable, ductile iron)	W	358,000	--	--	W	358,000
Superalloys	646,000	W	--	(3)	1,080,000	1,730,000
<b>Alloys (other than steels, cast irons, superalloys):</b>						
Welding materials (structural and hard-facing)	--	41,500	--	--	W	41,500
Other alloys	2,520	90,800	--	--	W	93,400
Mill products made from metal powder <sup>4</sup>	W	--	--	--	W	W
Cemented carbides and related products <sup>5</sup>	--	--	--	--	77	77
<b>Chemical and ceramic uses:</b>						
Pigments	W	--	11,100	--	--	11,100
Catalysts	937,000	--	(3)	--	W	937,000
Other	--	--	--	--	W	W
<b>Miscellaneous and unspecified uses:</b>						
Lubricants	--	--	--	--	196,000	196,000
Other	591,000	121,000	(3)	--	4,300,000	5,020,000
Grand total	8,520,000	4,370,000	11,100	--	5,710,000	18,600,000
Stocks, December 31	555,000	331,000	7,370	(6)	(6)	1,820,000

<sup>†</sup>Revised. W Withheld to avoid disclosing company proprietary data; included in "Miscellaneous and unspecified uses: Other." -- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Includes calcium molybdate.

<sup>3</sup>Withheld to avoid disclosing company proprietary data; included in "Miscellaneous and unspecified uses: Other" under "Other."

<sup>4</sup>Includes ingot, wire, rod, and sheet.

<sup>5</sup>Includes construction, mining, oil and gas, and metal working machinery.

<sup>6</sup>Withheld to avoid disclosing company proprietary data; included in "Total."

TABLE 4  
U.S. EXPORTS OF MOLYBDENUM PRODUCTS, BY PRODUCT AND COUNTRY<sup>1</sup>

Product and country	HTS <sup>2</sup> code	2012		2013	
		Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Oxides and hydroxides, gross weight: <sup>3</sup>	2825.70.0000				
Brazil		24	\$533	22	\$432
Canada		153	2,270	55	789
France		15	593	15	558
Japan		752	16,900	683	16,700
Korea, Republic of		3	33	12	193
Kuwait		18	383	106	1,280
Mexico		102	2,010	170	2,970
Netherlands		130	3,110	127	913
Russia		179	4,220	59	1,130
Turkey		120	2,320	52	1,050
Other (14 countries)		92 <sup>r</sup>	2,490 <sup>r</sup>	23	622
Total		1,590	34,900	1,320	26,400
Molybdates, all, gross weight: <sup>4</sup>	2841.70.0000				
Brazil		61	936	102	1,320
Canada		341	4,930	390	5,110
Korea, Republic of		25	464	77	919
Mexico		200	2,420	174	2,950
Netherlands		493	7,220	684	15,100
Other (33 countries)		405 <sup>r</sup>	6,360 <sup>r</sup>	310	5,880
Total		1,530	22,300	1,740	31,200
Ferromolybdenum, contained weight: <sup>4,5</sup>	7202.70.0000				
Canada		677	23,200	635	16,400
Mexico		188	5,620	156	4,500
Netherlands		77	2,580	49	1,290
Panama		--	--	13	370
Peru		--	--	7	195
Other (8 countries)		54 <sup>r</sup>	1,690 <sup>r</sup>	2	126
Total		996	33,100	862	22,900
Molybdenum, other, gross weight: <sup>3,6</sup>	Various <sup>7</sup>				
Canada		70	3,880	58	2,990
China		39	2,750	73	4,460
Germany		69	4,070	93	4,690
Israel		69	5,370	67	5,220
Japan		179	11,300	91	5,740
Korea, Republic of		429	34,900	158	25,800
Mexico		92	6,250	35	2,380
South Africa		(8)	6	66	1,420
Taiwan		121	8,010	75	4,530
United Kingdom		337	10,600	164	8,630
Other (57 countries)		442 <sup>r</sup>	24,400 <sup>r</sup>	181	12,900
Total		1,850	112,000	1,060	78,700

<sup>r</sup>Revised. -- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Harmonized Tariff Schedule (HTS) of the United States.

<sup>3</sup>Presentation of annual data is based on the quantities (gross weight or contained weight) of the ten leading countries in 2013.

<sup>4</sup>Presentation of annual data is based on the quantities (gross weight or contained weight) of the five leading countries in 2013.

<sup>5</sup>Ferromolybdenum contains about 60% to 65% molybdenum.

<sup>6</sup>Includes powder, unwrought, waste and scrap, wire, wrought, and other.

<sup>7</sup>Includes HTS codes 8102.10.0000, 8102.94.0000, 8102.95.0000, 8102.96.0000, 8102.97.0000, and 8102.99.0000.

<sup>8</sup>Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 5  
U.S. EXPORTS OF MOLYBDENUM ORE AND CONCENTRATES  
(INCLUDING ROASTED AND OTHER CONCENTRATES), BY COUNTRY<sup>1,2</sup>

Country	2012		2013	
	Quantity (metric tons of contained Mo)	Value (thousands)	Quantity (metric tons of contained Mo)	Value (thousands)
Belgium	6,190	\$169,000	3,770	\$75,200
Brazil	378	9,670	690	14,900
Canada	2,220	54,900	2,070	43,300
China	2,130	62,300	1,530	34,900
India	660	18,200	1,310	27,300
Japan	3,780	104,000	4,900	112,000
Korea, Republic of	420	12,300	898	21,700
Mexico	7,590	136,000	9,160	169,000
Netherlands	13,000	353,000	21,100	462,000
United Kingdom	6,450	184,000	2,380	55,300
Other (23 countries)	699 <sup>r</sup>	16,100 <sup>r</sup>	769	18,100
Total	43,500	1,120,000	48,600	1,030,000

<sup>r</sup>Revised. -- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Presentation of annual data is based on the quantities (gross weight or contained weight) of the ten leading countries in 2013.

Source: U.S. Census Bureau.

TABLE 6  
U.S. EXPORTS OF MOLYBDENUM PRODUCTS<sup>1</sup>

Item	HTS <sup>2</sup> code	2012			2013		
		Gross weight (metric tons)	Contained Mo (metric tons)	Value (thousands)	Gross weight (metric tons)	Contained Mo (metric tons)	Value (thousands)
Molybdenum ore and concentrates, roasted	2613.10.0000	NA	21,000	\$580,000	NA	22,200	\$498,000
Molybdenum ore and concentrates, other	2613.90.0000	NA	22,500	539,000	NA	26,400	534,000
Molybdenum chemicals:							
Oxides and hydroxides	2825.70.0000	1,590	NA	34,900	1,320	NA	26,400
Molybdates, all	2841.70.0000	1,530	NA	22,300	1,740	NA	31,200
Ferromolybdenum	7202.70.0000	1,440	996	33,100	1,240	862	22,900
Molybdenum powders	8102.10.0000	533	NA	22,700	250	NA	11,100
Molybdenum unwrought, bars and rods	8102.94.0000	291	NA	10,100	70	NA	2,620
Molybdenum waste and scrap	8102.97.0000	223	NA	4,150	149	NA	3,100
Molybdenum wire	8102.96.0000	120	NA	10,200	55	NA	5,210
Molybdenum, other	Various <sup>3</sup>	680	NA	64,400	537	NA	56,700
Total		XX	XX	1,320,000	XX	XX	1,190,000

NA Not available. XX Not applicable.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Harmonized Tariff Schedule (HTS) of the United States.

<sup>3</sup>Includes HTS codes 8102.95.0000 and 8102.99.0000.

Source: U.S. Census Bureau.

TABLE 7  
U.S. IMPORTS OF MOLYBDENUM PRODUCTS, BY PRODUCT AND COUNTRY<sup>1</sup>

Product and country	HTS <sup>2</sup> code	2012		2013	
		Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Oxides and hydroxides, gross weight: <sup>3</sup>	2825.70.0000				
Chile		303	\$6,080	80	\$1,430
China		178	3,570	200	3,910
Germany		20	322	--	--
Romania		--	--	2	34
Sweden		--	--	2	18
Other (3 countries)		31 <sup>r</sup>	610 <sup>r</sup>	--	--
Total		532	10,600	284	5,390
Molybdates, all, contained weight: <sup>3</sup>	Various <sup>4</sup>				
Belgium		8	467	1	151
Chile		282	9,260	204	5,670
China		184	5,770	405	11,200
India		1	77	1	40
Netherlands		( <sup>s</sup> )	4	1	47
Other (3 countries)		1 <sup>r</sup>	79 <sup>r</sup>	1	44
Total		476	15,700	613	17,200
Molybdenum orange, gross weight: <sup>3</sup>	3206.20.0020				
Canada		225	2,180	181	1,890
China		4	28	6	49
Colombia		108	618	64	375
Germany		18	83	20	100
Mexico		--	--	2	14
Total		355	2,910	273	2,430
Ferromolybdenum, contained weight: <sup>3,6</sup>	7202.70.0000				
Armenia		14	435	3	65
Canada		387	13,000	468	11,900
Chile		3,680	117,000	3,510	91,900
Japan		16	1,140	24	1,450
United Kingdom		145	3,600	87	2,520
Other (5 countries)		77 <sup>r</sup>	2,650 <sup>r</sup>	2	55
Total		4,320	138,000	4,090	108,000
Other, gross weight: <sup>7</sup>	Various <sup>8</sup>				
Austria		297	16,900	318	17,200
Canada		622	17,600	398	10,300
China		1,340	53,000	1,200	41,800
Germany		150	8,060	130	6,670
Hong Kong		40	1,540	41	1,350
Japan		40	1,590	59	1,710
Korea, Republic of		( <sup>s</sup> )	15	11	290
Russia		14	1,660	8	951
Taiwan		3	227	51	1,050
United Kingdom		21	924	24	825
Other (22 countries)		125 <sup>r</sup>	2,710 <sup>r</sup>	32	2,120
Total		2,650	104,000	2,270	84,300

<sup>r</sup>Revised. -- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Harmonized Tariff Schedule (HTS) of the United States.

<sup>3</sup>Presentation of annual data based on the quantities (gross weight or contained weight) of the five leading countries in 2013.

<sup>4</sup>Includes HTS codes 2841.70.1000 and 2841.70.5000.

<sup>5</sup>Less than ½ unit.

<sup>6</sup>Ferromolybdenum contains about 60% to 65% molybdenum.

<sup>7</sup>Presentation of annual data based on the quantities (gross weight or contained weight) of the ten leading countries in 2013.

<sup>8</sup>Includes HTS codes 8102.10.0000, 8102.94.0000, 8102.95.3000, 8102.95.6000, 8102.96.0000, 8102.97.0000, and 8102.99.0000.

Source: U.S. Census Bureau.

TABLE 8  
U.S. IMPORTS OF MOLYBDENUM ORE AND CONCENTRATES (INCLUDING  
ROASTED AND OTHER CONCENTRATES), BY COUNTRY<sup>1</sup>

Country	2012		2013	
	Quantity		Quantity	
	(metric tons of contained Mo)	Value (thousands)	(metric tons of contained Mo)	Value (thousands)
Canada	2,600	\$71,000	5,830	\$128,000
Chile	3,000	85,200	608	14,400
China	(2)	6	--	--
Mexico	4,440	48,600	3,700	35,200
Peru	1,950	94,000	2,890	109,000
South Africa	5	112	--	--
Sweden	(2)	8	19	410
United Kingdom	(2)	5	--	--
Vietnam	-- <sup>r</sup>	-- <sup>r</sup>	12	311
Total	12,000	299,000	13,100	287,000

<sup>r</sup>Revised. -- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 9  
U.S. IMPORTS FOR CONSUMPTION OF MOLYBDENUM PRODUCTS<sup>1</sup>

Item	HTS <sup>2</sup> code	2012			2013		
		Gross weight (metric tons)	Contained Mo (metric tons)	Value (thousands)	Gross weight (metric tons)	Contained Mo (metric tons)	Value (thousands)
Molybdenum ore and concentrates, roasted	2613.10.0000	10,100	6,170	\$100,000	6,870	4,160	\$47,100
Molybdenum ore and concentrates, other	2613.90.0000	11,900	5,810	199,000	18,100	8,890	250,000
Molybdenum chemicals:							
Oxides and hydroxides	2825.70.0000	532	NA	10,600	283	NA	5,390
Molybdates, all	Various <sup>3</sup>	854	476	15,700	1,080	612	17,200
Molybdenum orange	3206.20.0020	355	NA	2,910	274	NA	2,430
Ferromolybdenum	7202.70.0000	6,450	4,320	138,000	6,120	4,090	108,000
Molybdenum powders	8102.10.0000	408	362	16,700	448	433	16,000
Molybdenum unwrought, bars and rods	8102.94.0000	744	726	21,800	762	747	22,100
Molybdenum waste and scrap	8102.97.0000	971	925	31,400	739	690	21,900
Molybdenum wire	8102.96.0000	20	NA	2,760	23	NA	3,490
Molybdenum, other	Various <sup>4</sup>	507	NA	31,700	298	NA	20,800
Total		32,900	XX	570,000	35,000	XX	514,000

NA Not available. XX Not applicable.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Harmonized Tariff Schedule (HTS) of the United States.

<sup>3</sup>Includes HTS codes 2841.70.1000 and 2841.70.5000.

<sup>4</sup>Includes HTS codes 8102.95.3000, 8102.95.6000, and 8102.99.0000.

Source: U.S. Census Bureau.

TABLE 10  
MOLYBDENUM: WORLD MINE PRODUCTION, BY COUNTRY<sup>1,2</sup>

(Metric tons of contained molybdenum)

Country <sup>3</sup>	2009	2010	2011	2012 <sup>e</sup>	2013 <sup>e</sup>
Armenia	4,365	4,335	4,817	6,500 <sup>r</sup>	6,700
Canada	8,721	8,648	8,674 <sup>r</sup>	9,063 <sup>r</sup>	7,618
Chile	34,925	37,186	40,889	35,090	38,715 <sup>4</sup>
China <sup>e</sup>	93,500	96,600	103,000	105,000 <sup>r</sup>	101,000
Iran <sup>e</sup>	2,500 <sup>r,4</sup>	3,900 <sup>r</sup>	3,400	3,900 <sup>r</sup>	4,000
Mexico	10,166	10,849	10,787	11,366 <sup>r</sup>	12,100
Mongolia	2,140	2,198	1,960	1,903	1,900
Peru	12,297	16,963	19,141	16,790	18,140
Russia	4,562 <sup>r</sup>	4,495 <sup>r</sup>	4,843 <sup>r</sup>	4,800 <sup>r,e</sup>	4,800
Turkey	--	--	2,848 <sup>r</sup>	1,500 <sup>r</sup>	1,500
United States	47,800	59,400	63,700	61,500 <sup>r</sup>	60,700 <sup>4</sup>
Uzbekistan <sup>e</sup>	500	500 <sup>r</sup>	557 <sup>r,4</sup>	522 <sup>r,4</sup>	530
Total	221,000 <sup>r</sup>	245,000 <sup>r</sup>	265,000 <sup>r</sup>	258,000 <sup>r</sup>	258,000

<sup>e</sup>Estimated. <sup>r</sup>Revised. -- Zero.

<sup>1</sup>World totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Includes data available through July 25, 2014.

<sup>3</sup>In addition to the countries listed, the Republic of Korea, Kyrgyzstan, and Romania are thought to produce molybdenum, but output is not reported quantitatively, and available general information is inadequate to make reliable estimates of output levels.

<sup>4</sup>Reported figure.