



# 2014 Minerals Yearbook

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## ZEOLITES [ADVANCE RELEASE]

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# ZEOLITES

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In 2014, natural zeolites were mined by eight companies in the United States. Mine production decreased by 8% to 64,100 metric tons (t) from 69,500 t in 2013. Sales also decreased by 8% to 62,700 t from 68,300 t in 2013. The major markets for natural zeolites during 2014 were in animal feed, odor control, and water purification, in decreasing order by tonnage; these three applications accounted for more than 65% of domestic consumption. Exports of natural zeolites (other than gem quality) were estimated to be between 75 t and 275 t, and imports were thought to be less than 25 t. World production was estimated to be in the range of 2.7 to 3.2 million metric tons (Mt) (table 1).

Zeolite deposits in the United States are associated with the alteration of volcanic tuffs in alkaline lake deposits and open hydrologic systems; deposits predominantly occur in Arizona, California, Idaho, Nevada, New Mexico, Oregon, Texas, and Wyoming. Zeolites in these deposits are chabazite, clinoptilolite, erionite, mordenite, and phillipsite. Other components, such as orthoclase and plagioclase feldspar, montmorillonite, opal, quartz, and volcanic glass, are present in some deposits (Eyde and Holmes, 2006, p. 1040, 1042–1048).

Sustained mining of natural zeolites in the United States did not begin until the early 1970s. Prior to the 1950s, natural zeolites were considered to be mineralogical curiosities that filled vugs and fractures in igneous rocks. Large deposits of zeolite-rich volcanic tuffs were discovered in the Western United States during the late 1950s, and many large mining and petroleum companies conducted exploration programs between 1950 and the mid-1980s. Although these programs uncovered additional reserves, markets for natural zeolites did not develop as anticipated, and only a few hundred metric tons of zeolites were mined annually through the mid-1970s. By the mid-1980s, the major companies had withdrawn from the industry owing to low annual production and sales. Companies better suited to small-scale mining then stepped in and slowly developed the natural zeolite market into the small yet sustainable industry that exists today. Domestic production and sales have steadily increased since the 1970s, although in 1994, production experienced a significant decline because of an imbalance between production and market demand. Since the 1970s, zeolite markets have changed considerably. Zeolites were initially treated as bulk commodities, with producers seeking large volume markets. Pet litter applications became the mainstay of the industry, representing more than 50% of sales of natural zeolites annually in the mid-1980s. However, producers realized that low-value bulk sales of zeolites could not sustain the industry and began developing value-added applications. Pet litter applications currently command a far smaller share of the overall market, and growth has occurred in animal feed, gas absorbent, odor control, wastewater treatment, and water purification markets.

## Production

Domestic data for natural zeolites were collected by means of a voluntary survey of the domestic mining industry. Survey forms were sent to 13 mines and mills and responses were received from 10. Reported data accounted for 53% of the total production data. Data for nonrespondents were estimated from reported 2013 data adjusted to trends in production for reporting zeolite producers and Mine Safety and Health Administration (MSHA) employment data.

Eight companies mined natural zeolites in the United States in 2014 (table 2). Chabazite was mined in Arizona, and clinoptilolite was mined in California, Idaho, New Mexico, Oregon, and Texas. Domestic production of zeolites decreased to 64,100 t in 2014 compared with 69,500 t in 2013. By tonnage, New Mexico was the leading producer of natural zeolites in 2014, followed by Texas, Idaho, California, Oregon, and Arizona.

Owyhee Mining Company LLC had been pursuing a permit to reopen a zeolite mine in Malheur County, OR, for the past 5 years. In 2014, the company learned that an additional application would be required to mine the overburden layer above the zeolite deposit. The permit process was placed on hold while the company gathered more information. The 235-hectare site, located 56 kilometers west of Jordan Valley, OR, contained an estimated 45 Mt of zeolites (Meyer, 2014).

Conventional open pit mining techniques are used to mine natural zeolites. The overburden is removed to allow access to the ore. The ore may be blasted or stripped for processing by using front-end loaders or tractors equipped with ripper blades. In processing, the ore is crushed, dried, and milled. The milled ore may be air-classified based on particle size and shipped in bags or bulk. The crushed product may be screened to remove fine material when a granular product is required, and some pelletized products are produced from fine material. Producers also may modify the properties of the zeolite or blend their zeolite products with other materials before sale to enhance their performance (Eyde and Holmes, 2006, p. 1052–1053).

## Consumption

Sales of natural zeolites decreased to 62,700 t in 2014 compared with 68,300 t in 2013. Domestic uses for natural zeolites were, in decreasing order by tonnage, animal feed, odor control, water purification, other end uses, pet litter, wastewater treatment, gas absorbents (and air filtration), fertilizer carriers, oil absorbents, desiccants, catalysts, fungicide or pesticide carriers, aquaculture, and cement. Animal feed, odor control, water purification, pet litter, and wastewater treatment accounted for nearly 80% of the domestic sales tonnage.

Sales of natural zeolites increased for catalysts, gas absorbents, odor control, water purification, and other end

uses in 2014, and sales to animal feed, aquaculture, cement, desiccant, fertilizer carrier, fungicide or pesticide carrier, oil absorbent, pet litter, and wastewater treatment markets decreased. Among the specified end uses, sales to the gas absorbent market saw the greatest tonnage increase followed by water purification, and the greatest decrease in sales was, by tonnage, for cement followed by fungicide or pesticide carrier.

### Prices

Prices for natural zeolites vary with zeolite content and processing. Unit values, obtained through the U.S. Geological Survey canvass of domestic zeolite producers, ranged from \$110 to \$440 per metric ton. The bulk of the tonnage was valued between \$110 and \$220 per metric ton.

### Foreign Trade

Trade data were not available for natural zeolites because they are included under the generic U.S. Census Bureau Harmonized Tariff Schedule (HTS) code 2530.90.8050 (mineral substances not elsewhere specified or included). In 2014, exports of natural zeolites (other than gem-quality specimens) were estimated to be between 75 t and 275 t, a slight decrease from 2013. About 145 t of these exports were documented, with all shipments going to Denmark (IHS Inc., undated). Although some zeolites were shipped under the generic HTS code, others may have been shipped as part of an ion-absorption unit or labeled as ion-exchange media rather than as zeolite. U.S. imports in 2014 were thought to be less than 25 t. About 19.5 t of these imports were documented, with shipments originating from Turkey (approximately 17.6 t) and India (IHS Inc., undated). Most of the U.S. zeolite trade was in synthetic zeolite products.

### World Review

Most countries do not report natural zeolite production. Therefore, data in this section are estimated unless otherwise noted.

World production of natural zeolites remained in the range of 2.7 to 3.2 Mt in 2014. World production was unchanged from 2013 because of the continued economic uncertainties in countries where natural zeolites were sold in large volumes for construction uses.

Countries that mine large tonnages of zeolites typically use them in low-value applications. The ready availability of zeolite-rich rock at low cost and the shortage of competing minerals and rocks were probably the most important factors for its large-scale use. It was also likely that a significant percentage of the material sold as zeolites in some countries was ground or sawn volcanic tuff that contained only a small amount of zeolites. Some examples of such usage are dimension stone (as an altered volcanic tuff), lightweight aggregate, pozzolanic cement, and soil conditioners.

China was the leading producer of natural zeolites in 2014, with production likely in the range of 1.8 to 2.2 Mt (including zeolitic tuffs for pozzolanic cement applications). The second

leading producer was the Republic of Korea with 230,000 t; followed by the United States with 64,100 t (reported); Turkey with 40,000 to 50,000 t; Cuba with 44,000 t; Jordan with 13,000 t; Mexico with 2,000 to 2,500 t; and Indonesia with 1,500 t. Countries that produce zeolites, but for which insufficient data were available to make reliable production estimates include, Argentina, Armenia, Australia, Bulgaria, Canada, Georgia, Germany, Greece, Hungary, Iran, Italy, Japan, New Zealand, the Philippines, Russia, Serbia, Slovakia, Slovenia, South Africa, Spain, and Ukraine.

### Outlook

Although production and sales of natural zeolites decreased in 2014, market conditions in the United States and historic trends suggest domestic production and consumption is likely to remain unchanged or increase slightly in 2015. Worldwide, a significant portion of natural zeolite sales were linked to construction activities, where natural zeolites and (or) zeolitic tuffs were sold as dimension stone, lightweight aggregate, and pozzolanic cement. Because many countries continue to face economic uncertainties that could affect construction activities, world production and consumption are likely to remain essentially unchanged in 2015.

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## GENERAL SOURCES OF INFORMATION

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

		2010	2011	2012	2013	2014
United States:						
Production	metric tons	61,300	65,400	74,000	69,500	64,100
Sales	do.	60,000	65,200	70,500	68,300	62,700
Exports <sup>c</sup>	do.	<400	700–1,500	500–1,000	100–300	75-275
Imports <sup>c</sup>	do.	<150	<150	<5	<5	<25
World, production <sup>c</sup>	million metric tons	2.8–3.3	2.8–3.3	2.7–3.2	2.7–3.2	2.7-3.2

<sup>c</sup>Estimated. do. Ditto.

<sup>1</sup>Data are rounded to no more than three significant digits.

TABLE 2  
DOMESTIC ZEOLITE PRODUCERS, BY TYPE, IN 2014

State and company	Type of zeolite
Arizona:	
St. Cloud Mining, Inc.	Chabazite.
UOP LLC	Do.
California:	
KMI Zeolite Inc.	Clinoptilolite.
St. Cloud Mining, Inc.	Do.
Steelhead Specialty Minerals, Inc.	Do.
Idaho, Bear River Zeolite Co., Inc.	Do.
New Mexico, St. Cloud Mining, Inc.	Do.
Oregon, Teague Mineral Products	Do.
Texas:	
Daleco Resources Corp.	Do.
Zeotech Corp.	Do.
Do. Ditto.	