



# 2019 Minerals Yearbook

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## ZEOLITES [ADVANCE RELEASE]

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# ZEOLITES

By Robert D. Crangle, Jr.

Domestic survey data and tables were prepared by Michelle B. Blackwell, statistical assistant.

In 2019, natural zeolites were mined by seven companies in the United States. Mine production increased slightly to 87,800 metric tons (t) from 86,100 t in 2018, and sales decreased by 4% to 77,100 t in 2019 from 80,500 t in 2018. The major reported end uses for natural zeolites in 2019 were animal feed, water treatment, and odor control, in decreasing order of tonnage; these three applications collectively accounted for 62% of domestic sales. Imports and exports of natural zeolites (other than gem quality) in 2019 were each estimated to be less than 1,000 t. World production was estimated to be 835,000 metric tons (t), 9% less than that in 2018 (tables 1, 3).

Zeolites are a group of hydrated aluminosilicate minerals of the alkali and alkaline earth metals with a microporous crystalline structure. Approximately 50 naturally occurring zeolite minerals have been identified, but only a handful (chabazite, clinoptilolite, erionite, mordenite, and phillipsite) have commercial applications and are abundant in nature. Zeolites are valuable for a variety of absorption, filtering, and ion exchange applications because they contain loosely bound cations within their crystal lattice that can be exchanged with other cations or molecular water. Each zeolite mineral has a unique crystal structure that imparts distinct physical and chemical characteristics. Zeolite deposits in the United States were formed primarily by the alteration of volcanic tuffs in alkaline lake deposits, open hydrologic systems, and hydrothermal environments. They predominantly occur in Arizona, California, Idaho, Nevada, New Mexico, Oregon, Texas, and Wyoming (Eyde and Holmes, 2006, p. 1039–1048).

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 discovered additional resources, 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, most of the major companies had withdrawn from the industry owing to low annual production and sales. Small-scale mining companies then gradually developed the natural zeolites market into the small yet sustainable industry that exists today. Domestic production and sales have increased steadily since the early 1990s, although production significantly declined for a few years after 1994 owing to an imbalance between production and market demand. In 2019 mine production of natural zeolites was more than double that in 2000.

End uses for naturally occurring zeolite minerals have changed considerably since the 1970s. 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 annual sales in the mid-1980s. However, producers recognized that low-value bulk sales of zeolites could not sustain the industry and began developing value-added applications. Pet litter currently commands a far smaller share of the overall market, and usage in other applications such as in animal feed, fertilizer carrier, oil and gas absorbent, odor control, synthetic turf, traction control (ice melt), wastewater treatment, and water purification has increased.

Synthetic zeolites are manufactured by chemical processes and exhibit more uniform chemical composition, crystal lattice structure, and pore size than natural zeolites. Whereas natural zeolites have fixed properties, synthetic zeolites can be engineered to satisfy exact specifications for a particular application. Consequently, natural zeolites cost significantly less than their synthetic counterparts but are not suitable for certain commercial end uses. Synthetic zeolites are used primarily as water softening agents in detergents and catalysts in petroleum refining. Synthetic zeolites dominate the global zeolite market; the worldwide value of synthetic zeolite sales totals tens of billions of dollars, whereas the value of natural zeolite sales is probably on the order of tens of millions of dollars.

## Production

Domestic data for natural zeolites in 2019 were collected by means of a U.S. Geological Survey (USGS) voluntary canvass of the U.S. mining industry. Survey forms were received from six of the seven companies that operated 10 mines. Some survey data were incomplete, which required production and sales estimates for some mining locations.

Ten natural zeolite mines were active in 2019. The Owyhee Mining Co. (Medford, OR) received a mining permit in 2015 for a site near Rome, OR, but had not reached the commercial production stage by yearend 2018 (Bend Bulletin, The, 2015). In 2019, Owyhee formally abandoned that claim (Diggings, The, 2020). Chabazite was mined in Arizona, and clinoptilolite was mined in California, Idaho, New Mexico, Oregon, and Texas (table 2). Domestic mine production of natural zeolites increased slightly to 87,800 t from 86,100 t in 2018 (table 1). Most of the tonnage consisted of clinoptilolite. The remainder was mostly chabazite, with minor quantities of ferrierrite, mordenite, and phillipsite (Eyde, 2018). New Mexico was the leading producer of natural zeolites in 2019, followed by Arizona, California, Idaho, Oregon, and Texas, in alphabetical order. In 2019, KMI Zeolite, Inc. (Amargosa Valley, NV) published total reserves of 45 Mt (50 million short tons) with a zeolites purity of 97% (KMI Zeolite Inc., 2020).

## Consumption

In 2019, sales of natural zeolites decreased by 4% to 77,000 t compared with 80,500 t in 2018 (table 1). Major uses included animal feed, odor control, unclassified end uses (such as ice melt, soil amendment, synthetic turf, and so forth), water purification, pet litter, wastewater treatment, fungicide or pesticide carrier, oil and grease absorbent, gas absorbent (and air filtration), fertilizer carrier, desiccant, and aquaculture. Animal feed, odor control, and water purification applications likely accounted for about 70% of the domestic sales tonnage. Data for individual markets were withheld to avoid disclosing company proprietary data.

The 2018–19 agricultural season for corn, sorghum, barley, and oats included a slight decrease in harvested acreage of corn, slight increases in sorghum and barley, and an 8% increase in oats production from the previous agricultural season (U.S. Department of Agriculture, 2020). Comprehensive information regarding the sales trends for soil amendment, odor control, synthetic turf, and traction control was not available. Outside the United States, natural zeolites were used primarily in cement pozzolans and other construction materials, filtration, odor control, and soil amendments (Eyde, 2018).

## Prices

Prices for natural zeolites varied with the percentage of zeolites present in the product, the chemical and physical properties of the zeolite mineral(s), particle size, surface modification and (or) activation, and end use. In 2019, unit values (free on board, mine or plant) obtained through the USGS canvass of domestic zeolite producers ranged from an estimated \$100 to \$3,300 per metric ton. The average estimated unit value was roughly \$160 per metric ton, an increase of 11% from that in 2018.

## Foreign Trade

Comprehensive trade data were not available for natural zeolites because they were included under the generic U.S. Census Bureau Harmonized Tariff Schedule code 2530.90.8050 (mineral substances not elsewhere specified or included). Some zeolites may have been classified as part of ion-absorption units or labeled as ion-exchange media rather than as zeolites. Imports and exports of natural zeolites (other than gem-quality specimens) in 2019 were estimated to be less than 1,000 t each, unchanged from that in 2018. Nearly all of the U.S. zeolite trade was in synthetic zeolite products.

## World Review

Countries that mined large tonnages of zeolites typically used them in low-value, high-volume construction applications, such as dimension stone, lightweight aggregate, and pozzolanic cement. A significant percentage of the material sold in some countries also likely consisted of ground or sawn volcanic tuff that contained only a small proportion of zeolite minerals. Therefore, production data for some countries may not accurately indicate the quantities of natural zeolites used in the high-value applications reflected in their domestic production data of those countries. In addition, most countries either did

not report production of natural zeolites or reported output with a 2- to 3-year lag time. Therefore, data in this section were estimated except where otherwise noted.

World production of natural zeolites in 2019 was estimated to be 835,000 t, 9% less than that of 2018 (table 3). The Republic of Korea was the leading producer of natural zeolites, with an estimated 144,000 t. The second-ranked producer was Indonesia with 130,000 t, followed by Slovakia, 117,000 t, and New Zealand, 100,000 t. Countries thought to have produced natural zeolites, but for which insufficient data were available to make reliable production estimates, included Argentina, Armenia, Australia, Bulgaria, Canada, Georgia, Germany, Greece, Iran, Italy, Japan, Serbia, Slovenia, South Africa, Spain, and Ukraine.

## Outlook

The global detergents industry is expected to increase demand for zeolites in coming years (Wood, 2018). In the United States, a significant portion of natural zeolite sales are linked to livestock industries; zeolites are used in animal stalls to control odors and as an additive in animal feed to enhance nutrient uptake and reduce digestive issues. Globally, natural zeolite sales are linked to the construction industry, where zeolites and (or) zeolitic tuffs are sold as dimension stone, lightweight aggregate, and pozzolanic cement. Economic trends in these industries are expected to continue to influence production and sales of natural zeolites in the coming years.

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## GENERAL SOURCES OF INFORMATION

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

(Metric tons)

	2015	2016	2017	2018	2019
United States:					
Production	75,100	75,200	82,400	86,100	87,800
Sales	73,200	71,300	81,300	80,500	77,100
Exports <sup>e</sup>	<1,000	<1,000	<1,000	<1,000	<1,000
Imports <sup>e</sup>	<1,000	<1,000	<1,000	<1,000	<1,000
World production	1,150,000	1,140,000	1,080,000	913,000	835,000 <sup>e</sup>

<sup>e</sup>Estimated.

<sup>1</sup>Table includes data available through July 14, 2020. Data are rounded to no more than three significant digits.

TABLE 2  
 DOMESTIC NATURAL ZEOLITE OPERATIONS, BY TYPE, IN 2019<sup>1</sup>

State and company	Type of zeolite
Arizona:	
St. Cloud Mining Co. <sup>2</sup>	Chabazite.
UOP LLC	Do.
California:	
KMI Zeolite Inc.	Clinoptilolite.
St. Cloud Mining Co.	Do.
Idaho:	
Bear River Zeolite Co.	Do.
PDZ Co., LLC	Do.
New Mexico, St. Cloud Mining Co.	Do.
Oregon:	
PDZ Co., LLC	Do.
Teague Mineral Products	Do.
Texas, Zeotech Corp.	Do.
Do. Ditto.	

<sup>1</sup>Table includes data available through July 14, 2020.

<sup>2</sup>St. Cloud Mining Co. operates two natural zeolite mines in Arizona.

TABLE 3  
ZEOLITES: WORLD PRODUCTION, BY COUNTRY OR LOCALITY<sup>1</sup>

(Metric tons)

Country or locality <sup>2</sup>	2015	2016	2017	2018	2019
Chile	--	386	86	122	120 <sup>e</sup>
China	329,000	329,100	318,900	106,200	51,800
Cuba	50,800	52,800	56,500	52,600	53,000 <sup>e</sup>
Hungary	33,700	29,600	28,648	28,500 <sup>e</sup>	29,000 <sup>e</sup>
Indonesia <sup>e</sup>	200,000	210,000	130,000	130,000	130,000
Jordan <sup>e</sup>	13,000	14,000	15,000	10,000	10,000
Korea, Republic of	191,207	121,730	127,685	144,330	144,000 <sup>e</sup>
New Zealand	65,000	80,000	100,000	100,000 <sup>e</sup>	100,000 <sup>e</sup>
Philippines	8,468	6,177	4,127	3,600	4,000 <sup>e</sup>
Russia	15,000	37,000	35,000 <sup>e</sup>	35,000 <sup>e</sup>	35,000 <sup>e</sup>
Slovakia <sup>e</sup>	117,000	117,000	117,000	117,000	117,000
Turkey	55,224	71,568	63,250	99,848	73,354
United States	75,100	75,200	82,400	86,100	87,800
Total	1,150,000	1,140,000	1,080,000	913,000	835,000 <sup>e</sup>

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

<sup>1</sup>Table includes data available through March 14, 2022. All data are reported unless otherwise noted. 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>In addition to the countries and (or) localities listed, Argentina, Armenia, Australia, Bulgaria, Canada, Georgia, Germany, Greece, Iran, Italy, Japan, Serbia, Slovenia, South Africa, Spain, and Ukraine may have produced zeolites, but available information was inadequate to make reliable estimates of output.