



# 2015 Minerals Yearbook

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## VERMICULITE [ADVANCE RELEASE]

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# VERMICULITE

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

In 2015, U.S. production of vermiculite concentrate increased slightly, although reportable production remained at an estimated 100,000 metric tons (t) because of rounding to the nearest 100,000 t to avoid disclosing company proprietary data. (Percentages in this report were computed using unrounded data.) Worldwide vermiculite production was about 410,000 t in 2015, up 4% from that of 2014. Nearly 65,000 t of exfoliated vermiculite valued at \$50.1 million was sold or used in the United States in 2015, a 3% increase in quantity but a 3% decrease in value from that of 2014. U.S. exports of vermiculite were estimated to be about 2,000 t, down from about 3,000 t in 2014, and imports were estimated to be 21,000 t, a decrease of 51% from that of 2014 and slightly more than 50% less than the average imports of the previous 5 years (tables 1, 3, 4).

## Production

Vermiculite is a hydrated magnesium-aluminum-iron silicate. Raw vermiculite is similar in appearance to mica, contains water molecules within its internal structure, and ranges in color from black to various shades of brown to yellow. When vermiculite flakes are heated rapidly to a temperature of 900 °C or higher, the intermolecular water flashes into steam, and the flakes expand into accordion-like particles, which are gold or bronze in color. This expansion process is called exfoliation, and the resulting lightweight material is chemically inert, fire resistant, and odorless. Two U.S. producers accounted for all domestic crude vermiculite production, which increased slightly in 2015 (Moeller, 2016). Virginia Vermiculite LLC mined and processed vermiculite concentrate at its operation in Louisa County, VA, as did Grace Specialty Vermiculite (subsidiary of W.R. Grace & Co.) at its operations at Enoree and Woodruff, SC. Domestic production (sold or used) data for vermiculite were collected by the U.S. Geological Survey (USGS) from two voluntary canvasses—one for mine-mill (concentrator) operations and the other for exfoliation plants. Each producer responded to its respective surveys but, being proprietary, the data were withheld.

Virginia Vermiculite completed reclamation of its original vermiculite mine site and moved to mining vermiculite at an adjacent property while keeping its processing plant at the original site. The new mine site contains 20% to 25% vermiculite, and the overburden will be used in the future reclamation of the property, including a new 8-hectare (20-acre) lake (Gilbert, 2015).

Vermiculite concentrate was shipped to 14 companies operating 17 plants in 11 States for conversion into expanded lightweight products (table 2). In 2015, 65,000 t of exfoliated vermiculite sold or used by producers was valued at about \$50.1 million with a 6% decrease in average unit value (table 1).

Of the 18 exfoliation plants, 9 responded to the annual canvass, representing nearly 40% of the estimated sold or used exfoliated vermiculite tonnages listed in tables 1 and 3. Production data for nonrespondents were estimated based upon previous years' reported production levels. States that produced exfoliated vermiculite were, in descending order of tonnage, New Jersey, South Carolina, Pennsylvania, Florida, Massachusetts, Illinois, Arizona, Arkansas, Texas, Ohio, and New Mexico.

## Consumption

Vermiculite has a wide range of uses, particularly in the agricultural and construction industries, because of its attributes, including fire resistance, high liquid-absorption capacity, inertness, low density, and low thermal conductivity. In horticulture, vermiculite mixed with peat or other composted materials, such as pine bark, produces a soil-like material well suited as a growing medium for plants. To condition soil, vermiculite can improve the aeration of “sticky” (clay-rich) soils and the water-retention characteristics of sandy soils, reducing the likelihood of compaction, cracking, and crusting of the soil. These two uses accounted for about 45% of the exfoliated vermiculite sold or used in the United States in 2015 (table 3). Vermiculite also is used in the fertilizer and pesticide markets because of its ability to act as a bulking agent, carrier, and extender while providing some potassium, magnesium, and minor elements to plants. Vermiculite can absorb liquids, such as fertilizers, herbicides, and insecticides, which can then be transported as free-flowing solids.

Other major uses of vermiculite include insulation products and in lightweight aggregate applications, such as general building plasters and concrete products, for its lightweight and thermal insulation properties. Special plasters, including those used for fire protection and soundproofing, may use vermiculite combined with a binder, such as gypsum or portland cement, fillers, and other specialized additives. As insulation, exfoliated vermiculite, in some applications treated with a water repellent, is used to fill pores and cavities in hollow blockwork and masonry construction to enhance acoustic properties, fire rating, and insulation performance. Finer grades of exfoliated vermiculite, combined with potassium or sodium silicate, are used to produce insulation shapes. The ability of vermiculite-base insulation shapes to resist attack by molten aluminum makes them especially useful as secondary insulation in the aluminum production process. Other uses include refractory-insulation gunning and castable mixes and vermiculite dispersions. Finer grades of exfoliated vermiculite are used to partially replace asbestos in brake linings, primarily for the automotive market.

## Prices

Published prices for vermiculite serve only as a general guide because of variations in application, quantity, source, and other factors. U.S. domestic prices for vermiculite concentrate, ex-plant, largely dependent on grade sizing, ranged from \$140 to \$575 per metric ton in 2015, unchanged from 2014 prices. The value of imports into the United States in 2015, mostly coarser grades, bulk, free on board (f.o.b.) barge at Gulf Coast port, ranged from \$280 to \$1,100 per ton, on average up about 3% from \$300 to \$1,040 per ton in 2014 (Moeller, 2015, 2016). Coarser grained vermiculite with greater thermal expansion commands a higher price, but virtually none is produced in the United States.

The average unit value of U.S. exfoliated vermiculite sold or used by producers, using actual and estimated data, was about \$771 per ton in 2015, down 6% from \$823 per ton in 2014; this was a composite value of exfoliated vermiculite produced from domestic and imported concentrate (table 1).

## Foreign Trade

Trade data for vermiculite concentrate are not collected as a separate category by the U.S. Census Bureau but are included within the category “vermiculite, perlite, and chlorite, unexpanded” under Harmonized Tariff Schedule of the United States code 2530.10.0000. Trade data in this report are from PIERs, a U.S. trade database compiled by the Journal of Commerce (JOC Group Inc., 2016). Estimated U.S. exports of vermiculite—crude and concentrate—in 2015 were 1,709 t, with the United Kingdom receiving 70%; Germany, 11%; Israel, 6%; Japan and China, 3% each; and the remainder to several other countries. Total U.S. imports of vermiculite—crude and concentrate—(excluding any material from Canada and Mexico) were estimated to be about 21,000 t, with the majority coming from Brazil, 74%; China, 11%; Zimbabwe, 11%; and South Africa, 3%. Concentrates of coarser-than-medium particle size from high-yielding deposits, which have been increasingly less available in recent years, were imported mostly from China and South Africa.

## World Review

Global vermiculite production increased by 4% in 2015 to an estimated 410,000 t (table 4), in part owing to an increase in production from the world’s leading producer, Palabora Mining Co. Ltd. [a subsidiary of Palabora Copper (Pty) Ltd.] in South Africa (Ghilotti, 2016). Data from China, which may have produced significant quantities of vermiculite, were largely unavailable. Although mines and prospects in Brazil, Peru, and South Africa had the capability to increase the production of medium to coarse grades, expected production increases in 2015, especially of coarser grades, did not materialize. In Europe, demand was sluggish mostly owing to a continued lack of growth in the region’s construction industry. Coarser and more expensive grades, increasingly in higher demand in recent years, continued to be in short supply, and very fine sizes were in excess capacity (Palabora Mining Co. Ltd., 2013, p. 51; Moeller, 2016).

**Brazil.**—With reserves estimated to be 1.2 million metric tons (Mt) of vermiculite ore, Brasil Minérios Ltd. had an estimated production capacity of nearly 80,000 metric tons per year (t/yr) of vermiculite at its largest mine, the São Luís De Montes Belos Mine near Goiania in central Brazil. Brasil Minérios reported production of 60,379 t of crude vermiculite in 2013 and an estimated 56,400 t in 2014 (Brasil Departamento Nacional De Produção Mineral, 2016, p. 5). Its main plant was in Sao Luis (Brasil Minérios Ltd., 2015). In 2015, Brasil Minérios exported about 15,500 t of vermiculite to the United States, a 24% decrease from that of 2014 (JOC Group Inc., 2016). The company estimated sales of about 70,000 t for 2014 (Brasil Minérios Ltd., 2015). About 60% of its vermiculite products were exported, 50% of which were coarser grades and 50% finer grades, with sales in North America (50%), Europe (35%), and Asia (15%) (Torrissi and Patel, 2014).

Near Brasilia in Catalao, Goias State, Brasil Minérios owned the mining rights to vermiculite deposits containing estimated vermiculite ore reserves of 2 Mt (Elliott, 2011). The company planned to begin production at the Catalão Mine by 2016, bringing Brasil Minérios’ total production capacity to 200,000 t/yr in 2016 (Elliott, 2012b; Torrissi and Patel, 2014; Moeller, 2016). Brasil Minérios expected to meet Brazil’s domestic demand for vermiculite for 50 years, as well as export. Brasil Minérios has two exfoliation plants—one in Sanclerlandia, Goias State, and another in Cosmopolis, Sao Paulo State—with combined installed capacity of 15,000 cubic meters per month.

**Bulgaria.**—Wolff & Müller Minerals Bulgaria OOD, a German-Bulgarian joint-venture company, mined vermiculite ore from its Belitza opencast mine and further developed the nearby Verona vermiculite deposit in southwestern Bulgaria near the capital of Sofia from which there was limited production in 2015. The company processed the crude vermiculite ore into a concentrate in superfine- and micron-sized products and increased production capacity to 20,000 t/yr (Wolff & Müller Minerals Bulgaria OOD, 2015; Moeller, 2016).

**China.**—Production levels of vermiculite in China were not available, but the Vermiculite Association estimated annual Chinese exports of vermiculite currently to be 110,000 t, suggestive of similarly significant annual production (Ghilotti, 2016). About 2,200 t was exported to the United States (JOC Group Inc., 2016).

Xinjiang Yuli Xinlong Vermiculite Co., Ltd. produced vermiculite at its Xinlong Mine in the Bazhou area of Xinjiang Uyghur Autonomous Region. The Xinlong Mine, the top-producing vermiculite mine in China, had a capacity of 120,000 t/yr of vermiculite concentrate and 30,000 cubic meters per year of exfoliated vermiculite. The company’s leading product was a flake vermiculite concentrate ranging in size from 0.3 to 8.0 millimeters. The company exported most of its products, typically to developed countries and regions such as Europe, Hong Kong, Japan, the Republic of Korea, Taiwan, and the United States, but also sold domestically (Xinjiang Yuli Xinlong Vermiculite Co., Ltd., 2014).

**South Africa.**—In 2015, South Africa continued to be the world’s leading producer and exporter of vermiculite,

accounting for about 39% of estimated world production (table 4). From 2000 through 2015, on average, nearly 89% of the vermiculite produced in South Africa was exported. In 2015, an estimated 158,000 t was produced, most of which was mined by Palabora Mining Co. Ltd. (Ghilotti, 2016).

Under the ownership of a consortium consisting of South African and Chinese entities led by the Industrial Development Corporation (IDC) of South Africa Limited and China's Hebei Iron & Steel Group, the Palabora Mining Co. Ltd. increased production by an estimated 5% to 10% in 2015 from its mine in Limpopo Province (Ghilotti, 2016). In development activities, the company was extending its mining area beyond the current daily operations. A portion of the old pit had come to the end of its life and the company was unable to go deeper there owing to the water table. The new areas being prepared for opencast mining are equally rich in high purity vermiculite. The new mine, from which the mining of 1.5 Mt of ore will annually yield approximately 170,000 t of vermiculite for Palabora's growing global market, will extend the company's total mine life through 2033 (Industrial Minerals, 2016). Because of grade constraints and lower recovery rates from portions of the vermiculite ore body, the vermiculite product has continued to shift toward fine and superfine grades (Palabora Mining Co. Ltd., 2013, p. 4, 51, 149). Palabora Mining continued to face increased competition in the global vermiculite market including competition from the South American producers, but it regained some of its market share lost in the past few years, in part through competitive pricing (Palabora Mining Co. Ltd., 2014, p. 12, 38).

Palabora Mining marketed its vermiculite products through the company's Singapore office to its three international subsidiaries in Europe, North America (Palabora America Ltd. Vermiculite Division in Kennesaw, GA), and Australia (Palabora Mining Co. Ltd., 2014, p. 38).

**Uganda.**—The Namekara Mining Company Ltd., which owned and operated the Namekara vermiculite mine project in the Manafwa district of eastern Uganda, kept the mine on care-and-maintenance status. Sales of vermiculite supplies on hand were limited for much of the year owing to a 2011 Ugandan Government ban on the export of unprocessed minerals; the ban was lifted at the end of August, freeing the company to market existing vermiculite products including 1,400 t of vermiculite worth \$260,000 that had been awaiting export (East African Business Week, 2015a, b). Namekara Mining's holding company, African Phosphate Pty Ltd. of the Democratic Republic of the Congo [Congo (Kinshasa)], continued to seek a buyer for the project (Australian, The, 2016).

The Namekara deposit has about 55 Mt of inferred resources—including significant quantities of coarse and medium grades of about 20% and 30%, respectively—with sufficient resources to operate for more than 50 years at previously announced rates of production.

**Zimbabwe.**—Samrec Vermiculite (Pvt.) Ltd., a subsidiary of Imerys SA, conducted intermittent mining operations at the Shawa Mine (Moeller, 2016). Samrec operated the Shawa Mine, in the village of Buhera near the township of Dorowa, about 300 kilometers southeast of the capital of Harare. The Shawa Mine, a surface mining operation with ore to a depth of 40 meters, had an expected mine life of more than 30 years in

one of the largest vermiculite deposits in the world. In the fourth quarter of 2014, the most recent period for which information is publically available, the company reported the resumption of production at the rate of 40,000 t/yr. The ore, which included a significant portion of large flake vermiculite, was processed into concentrates, the majority of which was exported to Europe, Japan, and Taiwan (Lismore-Scott, 2014; Source, The, 2014).

On a smaller scale, Zimbabwe-based Wickbury Investments (Pvt.) Ltd. mined vermiculite in Buhera for transport to its beneficiation facilities in the capital city of Harare. The company invested \$1 million in improving its extraction and beneficiation facilities to produce exfoliated vermiculite for the domestic market. Wickbury marketed its product mainly to Zimbabwe's farming industry to slow the leaching of fertilizers from soil after excessive rainfall while also promoting the mineral's slow release of fertilizer to the soils. In drier areas, farmers would benefit from the mineral's ability to swell and store water; increase soil aeration; and transport and store nutrients, in both instances improving the long-term fertility of soils (Dickson, 2015).

## Outlook

Exploration and development of vermiculite deposits containing medium, large, and premium (coarser) grades (mostly in China and South Africa) are likely to continue to be driven by the higher demand for these larger grades. During the next several years, operations in Brazil and the United States are expected to help maintain regional and global supplies of fine, superfine, and micron grades. Although affected by political instability in recent years, continued production from the Shawa Mine in Zimbabwe may provide some of the needed supplies of coarser grades in the market.

Owing to increased demand and tight supplies for coarser grades of vermiculite, prices for coarser grades are expected to increase slightly through 2016. With oversupplies of the finer grades expected to continue, prices for those grades are expected to remain unchanged or decrease slightly through 2016.

With supplies of finer grades in excess capacity and far exceeding those of coarse grades for several decades, producers will continue to investigate more ways to increase the use of the finer grades in higher value markets and in existing products, such as a functional filler in coatings, fireproofing, friction brake applications, and insulation. To increase fire resistance in coatings and binders that form high-tensile-strength films, finer grades of vermiculite concentrate may be used as intumescent, the concentrate swelling (expanding) and promoting a less dense, passive barrier upon exposure to heat. Product lines may be developed for new uses, such as fine-sized to micron-sized grades of vermiculite to control air pollution and absorb water in mines, replace zeolite in ion-exchange columns, purify wastewater, or serve to contain or remove nuclear waste. Innovative approaches to existing technologies, such as Brazil Minérios' unique hybrid wash screen-dry winnower, hold promise for high-quality, cost-effective improvements in processing vermiculite concentrate using conventional technologies (Elliott, 2012a; Moeller, 2015, 2016).

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## GENERAL SOURCES OF INFORMATION

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

(Thousand metric tons and thousand dollars unless otherwise specified)

	2011	2012	2013	2014	2015	
United States:						
Production, concentrate <sup>2,3</sup>	100	100	100	100	100	
Exfoliated: <sup>c</sup>						
Quantity	62	59	64	63	65	
Value <sup>e</sup>	42,100	45,400	50,100	51,700	50,100	
Average value <sup>e</sup>	dollars per metric ton	673	766	779	823	771
Exports <sup>e,4</sup>	2	2	2	3	2	
Imports for consumption <sup>4</sup>	53	57	36	43	21	
World, production	394 <sup>r</sup>	370 <sup>r</sup>	378 <sup>r</sup>	395 <sup>r</sup>	410 <sup>c</sup>	

<sup>c</sup>Estimated. <sup>r</sup>Revised.

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

<sup>2</sup>Sold or used by producers.

<sup>3</sup>Rounded to the nearest 100,000 metric tons to avoid disclosing company proprietary data.

<sup>4</sup>Source: JOC Group Inc., 2016, PIERS: Newark, NJ, JOC Group Inc. (Accessed April 7, 2016, via <http://i.piers.com/Login.aspx?ReturnUrl=/app/Default.aspx>.)

TABLE 2  
ACTIVE VERMICULITE EXFOLIATION PLANTS IN THE UNITED STATES IN 2015

Company	County	State
Fireproofing Products, Inc.	Bernalillo	New Mexico.
Isolatek International Inc.	Sussex	New Jersey.
J.P. Austin Associates Inc.	Beaver	Pennsylvania.
Palmetto Vermiculite Co. Inc.	Spartanburg	South Carolina.
P.V.P. Industries, Inc.	Trumbull	Ohio.
Schundler Co., The	Middlesex	New Jersey.
Specialty Vermiculite Corp.	Maricopa	Arizona.
Do.	Broward	Florida.
Do.	Laurens	South Carolina.
Sun Gro Horticulture Canada Ltd.	Jefferson	Arkansas.
Do.	LaSalle	Illinois.
Thermal Ceramics Inc.	Macoupin	Do.
Therm-O-Rock East, Inc.	Washington	Pennsylvania.
Therm-O-Rock West, Inc.	Maricopa	Arizona.
Vermiculite Industrial Corp.	Allegheny	Pennsylvania.
Vermiculite Products Inc.	Harris	Texas.
Whittemore Co., Inc.	Essex	Massachusetts.
Do. Ditto.		

TABLE 3  
ESTIMATED EXFOLIATED VERMICULITE SOLD OR  
USED IN THE UNITED STATES, BY END USE<sup>1</sup>

(Metric tons)

	2014	2015
Aggregates <sup>2</sup>	9,290	10,500
Insulation <sup>3</sup>	4,140	3,690
Agricultural:		
Horticultural	20,600	20,400
Soil conditioning	10,100	8,430
Fertilizer carrier	W	W
Total	W	W
Other <sup>4</sup>	W	W
Grand total <sup>5</sup>	63,000	65,000

W Withheld to avoid disclosing company proprietary data; included in "Grand total."

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

<sup>2</sup>Includes concrete, plaster, and premixes (acoustic insulation, fireproofing, and texturizing uses).

<sup>3</sup>Includes loose-fill, block, and other (high-temperature and packing insulation and sealants).

<sup>4</sup>Includes various industrial and other uses not specified.

<sup>5</sup>Rounded to two significant digits because of estimated data.

TABLE 4  
VERMICULITE: WORLD PRODUCTION, BY COUNTRY<sup>1,2</sup>

(Metric tons)

Country <sup>3</sup>	2011	2012	2013	2014	2015 <sup>e</sup>
Argentina <sup>e</sup>	1,000	320 <sup>4</sup>	1,000	1,000	1,000
Brazil, concentrate	54,970	51,986	68,014	68,000 <sup>r,e</sup>	68,000
Bulgaria <sup>e</sup>	15,000	18,600	18,600	19,000 <sup>r</sup>	19,000
Egypt <sup>e</sup>	2,865 <sup>r,4</sup>	3,000	3,000	3,000	3,000
India	12,454	8,315	9,554	10,176 <sup>r</sup>	10,000
Kenya <sup>e</sup>	515 <sup>4</sup>	457	400 <sup>r</sup>	440 <sup>r</sup>	450
Russia	21,000 <sup>r</sup>	21,800 <sup>r</sup>	20,931 <sup>r</sup>	21,000 <sup>r,e</sup>	21,000
South Africa	170,571	132,886	127,658	143,007 <sup>r</sup>	158,290 <sup>4</sup>
Uganda	8,426	11,251	243	--	-- <sup>4</sup>
United States, concentrate, sold and used by producers <sup>e,5</sup>	100,000	100,000	100,000	100,000	100,000
Zimbabwe	7,228	21,625	28,808	29,500 <sup>r</sup>	29,000
Total	394,000 <sup>r</sup>	370,000 <sup>r</sup>	378,000 <sup>r</sup>	395,000 <sup>r</sup>	410,000

<sup>e</sup>Estimated. <sup>r</sup>Revised. NA Not available. -- Zero.

<sup>1</sup>World totals 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 April 21, 2016.

<sup>3</sup>In addition to the countries listed, Australia, China, and Japan produced vermiculite, but available information is inadequate to make reliable estimates of output.

<sup>4</sup>Reported figure.

<sup>5</sup>Rounded to one significant digit to avoid disclosing company proprietary data.