



# 2017 Minerals Yearbook

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## FELDSPAR AND NEPHELINE SYENITE [ADVANCE RELEASE]

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# FELDSPAR AND NEPHELINE SYENITE

By Zachary T. Ghalayini

Domestic survey data and tables were prepared by Raymond I. Eldridge III, statistical assistant.

In 2017, feldspar production in the United States was estimated to be 440,000 metric tons (t) valued at \$27.8 million, a 6% decrease in quantity and a 16% decrease in value compared with those of 2016 (table 1). Exports of feldspar in 2017 decreased by 9% to 5,340 t, valued at \$1.21 million, and imports of feldspar were 290,000 t, valued at \$7.51 million, nearly eight times the quantity imported in 2016 (tables 5, 6). The dramatic increase in imports of feldspar was the result of increased imports from Turkey, as reported by the U.S. Census Bureau. Imports of nepheline syenite (predominantly from Canada) more than doubled to 1.46 million metric tons (Mt) valued at \$88.4 million. Increased imports resulted in apparent domestic consumption doubling in 2017. World production of feldspar in 2017 was 24.7 Mt (tables 1, 7).

Feldspars, which constitute about 60% of the earth's crust, are anhydrous aluminosilicate minerals of two main groupings: potassium- to sodium-alkali feldspars and sodium- to calcium-plagioclase feldspars. The alkali feldspars mostly are used in glassmaking and ceramics, and the plagioclase feldspars, especially the sodium-rich varieties, are mainly used in ceramics and various construction applications. Plagioclase of higher calcium content is used for its alumina content across multiple construction products, such as fiberglass or for the strengthening of glass-reinforced plastic products. In a broader sense, by volume, much of the sand and gravel used as aggregate in concrete and asphalt is composed of plagioclase, and plagioclase is an important constituent of some building stones. Nepheline syenite is an essentially quartz-free igneous rock composed of alkali feldspars and nepheline, which is a feldspathoid mineral that forms in place of alkali feldspars because the magma (melt) was deficient in silica. Nepheline syenite has many uses similar to those of alkali feldspar.

United States apparent consumption of domestic and imported feldspar and imported nepheline syenite from Canada combined was more than 2 Mt, primarily in ceramics and glass production for use in the construction industry and glass for use in the automotive sector; both also were used as filler in various products, such as paints and coatings (tables 1, 4). Domestic feldspar production data include feldspar-quartz mixtures from silica producers and aplite (a rock with quartz and feldspar as the dominant minerals) from one producer. Domestic nepheline syenite production primarily was used in the production of roofing granules, but it was also used in the production of ceramic and porcelain tiles and other construction applications.

## Feldspar

**Production.**—Data on domestic production, sales, and use of feldspar in this chapter were collected by the U.S. Geological Survey (USGS) using responses from voluntary surveys. Production for nonreporting operations was estimated by using previous years' submissions and worker-hour reports

from the U.S. Department of Labor's Mine Safety and Health Administration. Of the seven companies that produced feldspar, five responded to the canvass, representing about 40% of the 2017 production tonnages listed in tables 1 and 2.

Feldspar was mined in six States (table 3). North Carolina was by far the leading producer State; the remaining five were, in descending order of estimated output, Virginia, California, Idaho, South Dakota, and Oklahoma. Production was from 10 mines and beneficiating facilities—4 in North Carolina, 2 in California, and 1 in each of the four remaining States (table 3).

I-Minerals Inc. announced in May that the Idaho Department of Lands had approved the mine permitting process for its Helmer-Bovill project in north-central Idaho; the mine would produce potassium feldspar, halloysite, kaolin, and quartz (I-Minerals Inc., 2017b). In 2016, pilot plant work by an independent laboratory resulted in a potassium feldspar product with 13% to 14% potassium oxide ( $K_2O$ ) and low iron [0.03% ferric oxide ( $Fe_2O_3$ )] content (I-Minerals Inc., 2017a). The company produced small quantities of feldspathic (feldspar-quartz) sands from its WBL Tailings resource area, which was adjacent to the Helmer-Bovill property, for use in the production of ceramic tiles. The WBL Tailings are feldspar- and quartz-rich materials that were left on the property from 1960 to 1974 by the former mine operator, who then focused on kaolin production from the ores. I-Minerals' reclamation mining permit allows it to mine about 45,000 metric tons per year (t/yr) of feldspathic sand from the WBL Tailings between June and October of each year through 2022. Feldspar-quartz sand from the WBL Tailings was sold to Quarry Tile Co.'s tile plant in Spokane, WA. In addition to providing a revenue stream, the sale of sands from WBL reduced the tailings storage requirements for the company (I-Minerals Inc., 2014). WBL Tailings was one of three mineral-resource areas on the Helmer-Bovill property, a multiminerals project from which the company expected production of 47,000 t/yr of potassium feldspar during a projected 25-year mine life (I-Minerals Inc., 2016).

**Consumption.**—In 2017, approximately 66% of domestic feldspar sold or used was consumed in the manufacture of glass, including glass containers, flat glass, specialty glass, and fiberglass for home insulation; feldspar use for glass increased by about 3% (table 4). In glassmaking, feldspar promotes the mixing of the melt components by fluxing (reducing the melt viscosity and the melting temperature) the system. The alkalis in feldspar (especially potassium and sodium ions) lower the melting temperature within the mix and promote the melting of and chemical bonding of the other glass batch minerals, such as quartz, to produce glass. Alumina and calcium ions in feldspar impart increased resistance to physical and chemical breakdown of the glass product.

Much of the remaining feldspar consumption was in the manufacture of ceramics, including ceramic and porcelain

tile, electrical insulators, sanitaryware, and tableware. In ceramics, as in glassmaking, the alkalis (calcium, potassium, and sodium) in feldspar act as a flux, working with soda ash to lower the melting temperature of the mixture while increasing the fusibility of the batch materials. Feldspar also controls the degree of vitrification of the ceramic body during firing. Smaller quantities of feldspar are used as fillers and extenders in paint, plastics, and rubber.

The construction industry was a significant consumer of glass and ceramic products, particularly for windows, flooring, and sanitaryware. In the United States, construction starts for new private housing increased slightly to 1.20 million units in 2017, up from 1.17 million units in 2016. This upward trend has continued since 2010. The 2017 housing starts, however, remained lower than those of many of the years from 1959 through 2007 (U.S. Census Bureau, 2018b). The value of total construction put in place, which uses significant quantities of flat glass and ceramic tile products, increased for the sixth consecutive year, up by 4.5% to nearly \$1.25 trillion in 2017 from \$1.19 trillion in 2016, both having surpassed the previous peak of \$1.16 trillion in 2006 (U.S. Census Bureau, 2018a).

In 2017, the United States became the leading importer of ceramic and porcelain tiles, which accounted for nearly 71.4% of domestic tile consumption; the four leading suppliers were China (30%), Mexico (18%), Italy (18%), and Spain (13%). Exports of tile in 2017 decreased by 21%, with the majority going to Canada (75%) and Mexico (8%) (Whitmire, 2018).

Porcelain tile, which is less porous than ceramic tile, increasingly was becoming the tile of choice in the United States; the majority of U.S. imports of flooring tiles in 2017 were porcelain rather than ceramic. In 2016, Dallas-based Dal-Tile Corp. (a subsidiary of Mohawk Industries Inc.) began operation of its first tile kiln at its \$180 million, 167,000-square-meter glazed porcelain and colorbody tile manufacturing plant in Dickson, TN. Dal-Tile plans to build a second facility in Dickson with production expected to begin in 2018 (Gadd, 2017). Also taking advantage of the proximity of critical raw materials for the tile industry, such as clays and feldspar, Landmark Ceramics (the North American subsidiary of Italy-based Gruppo Concorde) completed construction of a \$90 million, 70,600-square-meter porcelain ceramic tile plant at Mt. Pleasant, TN, in late 2016 (Powell, 2016). In June, China-based Wonder Porcelain LLC began operation at its recently completed \$150 million, 46,500-square-meter ceramic tile plant in Lebanon, TN (American Wonder Porcelain, 2017).

**Foreign Trade.**—In 2017, about 77% of United States exports of feldspar went to Canada, 8% to Colombia, 4% to Japan, and most of the remainder to countries in Central America (table 5). In 2017, many imports of feldspar continued to be from Turkey (table 6). Feldspar imports from Turkey have experienced a sevenfold increase from 2016, and the average unit value of feldspar imports from Turkey declined from about \$77 per metric ton to about \$24 per metric ton. Two companies imported most of the shipments of feldspar from Turkey—a manufacturer of ceramic and porcelain floor and wall tiles and a producer and supplier of raw materials used in the production of ceramic tiles and sanitaryware.

**World Review.**—More than 70 countries had significant resources of feldspar and more than 40 produced feldspar in 2017; world production was 24.7 Mt. The leading feldspar-producing countries in 2017 were Turkey, China, and Italy, followed by India, Thailand, and Iran, in descending order of production (table 7).

As in the United States, feldspar consumption worldwide was mostly for glassware and ceramics. Global ceramic tile production, about 50% of which was for floor tile, increased slightly to nearly 13.6 billion square meters, with the most substantial increase in Africa (Biral di, 2018a, p. 58, 60). China, the world's leading tile producer, accounted for 47% of world production, and India and Brazil ranked second and third, respectively, the former with a 13% increase in production and the latter with a slight decrease. Ceramic tile production increased most notably in Egypt (by 20%), Vietnam (by 16%), India (by 13%), and Iran (by 10%). Global consumption of ceramic tile increased slightly to 13.3 billion square meters. China, the world's leading ceramic tile consumer, accounted for 41% of world consumption, and India and Brazil ranked second and third, respectively (Biral di, 2018a, p. 62, 64).

China continued to be the leading exporter of tile with 33% of world exports, although exports from China decreased for the fourth consecutive year. Spain ranked second, accounting for 15% of global tile exports, and Italy was third with 12% of exports. Exports from Spain and Italy increased by 3% and slightly, respectively, and exports, in descending order of increase, from India, Iran, and Turkey increased significantly (Biral di, 2018a, p. 66).

**China.**—Feldspar was mined in the eastern and southeastern Provinces of China, and national production was estimated to rank second globally for the first time with slightly higher output than Italy. China produced an estimated 4.0 Mt of feldspar in 2017, which was used in the production of ceramic tile, sanitaryware, and tableware. Porcelain tile was the primary type of ceramic tile produced, followed by polished and antique-style flooring. The country's ceramic tile output decreased slightly to 6.4 billion square meters, of which nearly 910 million square meters was exported (Biral di, 2018a, p. 62, 66). China produced about one-third of the world's sanitaryware, accounting for 47.8% of world exports in 2017 (Biral di, 2018b, p. 89).

**Greenland.**—Hudson Resources Inc. continued work on its Naajat (White Mountain) anorthosite (calcium-rich plagioclase feldspar) project in western Greenland; the project had an inferred resource of 27 Mt. In 2017, Hudson made significant progress on construction of project infrastructure. The company planned to produce 200,000 t/yr of anorthosite, with a substantial portion to be sold to Owens Corning Inc. for use as feed material at its fiberglass plants. Hudson had a 10-year supply contract with Owens Corning with an option to extend for successive 10-year periods. Owing in part to a late revision in the process plant design and other delays, Hudson expected to begin production by the second half of 2018 (Patel, 2015; Hudson Resources Inc., 2017a, b). Owens Corning planned to use the Naajat anorthosite for making electrical-grade glass (E-glass), which is the most common glass fiber used in

composites, fabrics, and glass-reinforced plastics for products where strength and high electrical resistivity are required. Additional potential applications for the anorthosite were cited as an alumina source in making refractories and ceramics; as filler and coating material for paints, paper, and plastics; and potentially as a feed for aluminum smelters (Hudson Resources Inc., 2014). The project's environmental impacts were expected to be low because it is, essentially a rock quarry and dock facility with nearby access to shipping on the tidewater and because of the purity of the ore, thereby not requiring chemicals or water for onsite processing (Hudson Resources Inc., 2013).

**India.**—Of the estimated 1.5 Mt of feldspar that was produced in India during 2017, about 510,000 t (34%) was exported, up 4% from 2016 (United Nations Statistics Division, undated a). In 2016, the latest year for which data were available, total domestic consumption of feldspar was about 602,000 t in the organized sector (generally large-scale operations that were incorporated by the Government of India and therefore required to follow Government regulations regarding employees). Domestic consumption was divided among the ceramics industry, with 78%; the glass industry, 13%; the cement industry, 9%; and a negligible amount in other sectors (Indian Bureau of Mines, 2018).

**Italy.**—Most of Italy's feldspar output was consumed in the domestic ceramics industry. In 2017, the country exported 276,000 t of feldspar, 94% of which went to Spain. Italy imported about 2.79 Mt of feldspar, of which 93% was from Turkey, and nearly 6% was from France (United Nations Statistics Division, undated a). Production of ceramic tile, the leading sector of the country's ceramics industry, increased slightly to 422 million square meters in 2017 from 416 million square meters in 2016 (Biraldi, 2018a, p. 62). Total exports for the ceramic tile industry increased slightly to 338 million square meters in 2017, with 51% of exports going to Western Europe (Biraldi, 2018a, p. 70).

**Turkey.**—Turkey was the world's leading feldspar producer with an estimated 7.15 Mt in 2017 (table 7). Feldspar was mined in the southwestern part of Anatolia, mainly from the Mendere Massif. Most of the country's production was exported, the majority of which went to Italy (36%), Spain (31%), and the United States and Russia (about 4% each) (United Nations Statistics Division, undated a).

## Nepheline Syenite

**Production.**—The only deposit of nepheline syenite mined in the United States was in Arkansas, where three operations produced the material primarily for use as roofing granules by the asphalt shingle industry and in lesser quantities as a flux in the manufacture of ceramic and porcelain floor tile in the southern and southeastern United States. It also was used in the manufacture of ceramic bricks and for asphalt and concrete aggregates and related products. In the production of bricks and darker body ceramic tiles, use of nepheline syenite from the Arkansas deposit, which typically contained 3% or more iron oxide, lowered the temperature of the melt more than a nepheline syenite (or feldspar) of lower iron content and resulted in a darker colored product. Nepheline syenite was produced by two companies: 3M Co. (Industrial Mineral Products Division)

and Granite Mountain Quarries Co. (a subsidiary of McGeorge Contracting Co. Inc.). 3M mined nepheline syenite from the Arch Street Mine, which was also a crushed-stone-producing facility that had been active since the 1930s. Although 3M primarily produced roofing granules from its nepheline syenite, it was the leading U.S. producer of nepheline syenite for the tile industry and supplied nepheline syenite to the brick industry. Granite Mountain Quarries Co. produced nepheline syenite from Granite Mountain Quarry #1 and Granite Mountain Quarry #2 mostly for use as construction aggregates supplied to its sister construction companies and for use as railroad ballast. All three properties are to the south and southeast of Little Rock, AR (Jay Lukkarila, Mining Engineer, 3M Co. Industrial Products Division, written commun., June 15, 2017; U.S. Department of Labor, Mine Safety and Health Administration, 2018).

**Consumption.**—In glass and ceramics manufacture, nepheline syenite, like feldspar, provides alkalis that act as a flux. In a glass, nepheline syenite also supplies alumina, imparting the same benefits as feldspar. Nepheline syenite also typically is used as a filler in adhesives, paint, plastics, and sealants, and it can be used in the production of aluminum and fertilizers as well as a construction aggregate. During the past several years, the consumption of Arkansas nepheline syenite for the manufacture of porcelain floor tile in the United States has increased.

**Foreign Trade.**—Exports increased by about 86% in 2017 from those of 2016. In 2017, about 6,400 t of the material was exported to several countries, most notably to Canada and Mexico (28% each) and Belgium (21%). Since 2012, imports of nepheline syenite from Canada have been on average 45% higher than those during the preceding decade (table 1) (U.S. Census Bureau, 2018c).

**World Review.**—Nepheline syenite was produced in Brazil, Canada, China, Norway, Russia, and Turkey for feldspathic uses. The leading producing company was Belgium-based SCR-Sibelco NV, through its subsidiaries Sibelco Europe in Norway and Unimin Corp. in Canada. Others included Finetion Industrial Minerals Ltd. in China and OJSC Apatit AG and United Company RUSAL Plc in Russia.

**Canada.**—Canada's sole nepheline syenite producer, Unimin, operated two mines about 175 kilometers northeast of Toronto, Ontario—one at Blue Mountain and the other at Nephton. Production of marketable nepheline syenite was estimated to be 612,000 t in 2017, up 7% from 571,000 t in 2016 (Natural Resources Canada, 2018). The material was consumed in the glass, ceramics, filler, and abrasives markets. Canada's nepheline syenite exports were 1.48 Mt in 2017, up 152% from 585,000 t in 2016 (United Nations Statistics Division, undated b); 1.46 Mt was exported to the United States, up 155% from 572,000 t in 2016 (table 1).

**Norway.**—Sibelco Europe produced nepheline syenite in the summer and autumn from an open pit on the Arctic Island of Stjernoy. Onsite processing of the ore (crushing, drying, milling, sieving, magnetic separation, and air classification) resulted in various products for the glass, ceramics, and paint industries and desulfurization of steel. In 2017, exports of nepheline syenite from Norway were 321,000 t. About 25% of the exports were to Poland, 25% to the Netherlands, 14% to Germany,



12% to Spain, 11% to the United Kingdom, and 6% to France (United Nations Statistics Division, undated b).

**Russia.**—The Kiya-Shaltyr Mine on the Goryachegorsk Massif in east-central Siberia, operated by RUSAL, produced 4.3 Mt of nepheline ore, a 2% decrease from 4.4 Mt produced in 2016, for use in the production of alumina. RUSAL accounted for approximately 6% of the global production of alumina and aluminum (United Company RUSAL Plc, 2018, p. 11, 58).

In 2017, phosphate producer PJSC PhosAgro AG, through its subsidiary OJSC Apatit, was Russia's only producer of nepheline concentrates. At the Apatit mining and beneficiation complex, the company mined and processed apatite-nepheline ore from the Khibiny deposit on the Kola Peninsula in the Murmansk region of northwestern Russia. The Apatit operation produced phosphate rock, nepheline concentrates, and other mineral concentrates. In 2017, nepheline concentrate production increased by 4% to 998,000 t and sales increased by 3% to 1,001,800 t, with all sales going to Basel Cement Pikalevo (PJSC PhosAgro AG, 2018, p. 60).

## Outlook

Production and transportation costs for U.S. producers of feldspar and nepheline syenite are expected to increase, and domestic feldspar producers may find increasing competition from imports. Feldspar producers also may continue to compete with domestic nepheline syenite used in the production of some ceramic tiles and imported nepheline syenite in the production of glass and ceramic products.

Sales of glass food containers in the United States are expected to continue to increase slightly during the next several years because of consumer demand and Federal and State government initiatives for environmentally friendly and recyclable food and beverage packaging; this increase would likely increase feldspar consumption by glass container manufacturers. However, significant growth in glass container recycling and the use of cullet could reduce the quantities of raw materials needed to manufacture these containers.

In the United States, new residential construction and commercial and residential remodeling are expected to increase, creating a higher demand for ceramics, fiberglass, and glass, and thus for feldspar and nepheline syenite. Consumption of domestic ceramic tile is expected to continue to rise in 2018 (Whitmire, 2018).

Worldwide, demand for ceramic tile is expected to rise because of increases in construction and the residential replacement (remodeling) market, especially in the growing economies of China, Japan, and India. Although consuming much of its output, China is likely to continue to be the leading exporter of ceramic tile. The recent use of inkjet technology to design relatively affordable ceramic tiles with the realistic appearance of hardwood and other flooring materials may be another factor for growth in the industry (Occams Business Research & Consulting Pvt. Ltd., 2017).

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TABLE 1  
SALIENT FELDSPAR AND NEPHELINE SYENITE STATISTICS<sup>1</sup>

		2013	2014	2015	2016	2017
United States:						
Production, feldspar: <sup>e, 2</sup>						
Quantity <sup>3</sup>	metric tons	550,000	530,000	520,000	470,000	440,000
Value	thousands	\$40,100	\$34,800	\$37,300	\$33,100	\$27,800
Exports, feldspar: <sup>4</sup>						
Quantity	metric tons	17,700	16,000	15,100	5,890	5,340
Value <sup>5</sup>	thousands	\$5,310	\$5,880	\$4,920	\$1,520	\$1,210
Imports for consumption: <sup>4</sup>						
Feldspar:						
Quantity	metric tons	4,310	7,910	120,000	36,900	290,000
Value <sup>6</sup>	thousands	\$1,110	\$3,120	\$7,090	\$3,430	\$7,510
Nepheline syenite:						
Quantity	metric tons	491,000	503,000	449,000	572,000	1,460,000
Value <sup>6</sup>	thousands	\$59,300	\$64,000	\$67,600	\$73,000	\$88,400
Consumption, apparent <sup>e, 3, 7</sup>	metric tons	1,000,000	1,000,000	1,100,000	1,100,000	2,200,000
World, production, feldspar	thousand metric tons	22,400	23,900 <sup>r</sup>	25,100 <sup>r</sup>	23,800 <sup>r</sup>	24,700

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

<sup>1</sup>Table includes data available through July 1, 2019. Data are rounded to no more than three significant digits.

<sup>2</sup>Includes hand-cobbed feldspar, flotation-concentrate feldspar, feldspar in feldspar-quartz mixtures, and aplite; for use predominantly in the production of ceramics and glass, may differ from sales in table 4.

<sup>3</sup>Rounded to two significant digits to avoid disclosing company proprietary data.

<sup>4</sup>Source: U.S. Census Bureau.

<sup>5</sup>Free alongside ship (f.a.s.) value.

<sup>6</sup>Customs value.

<sup>7</sup>Production plus imports minus exports. Includes feldspar and imported nepheline syenite.

TABLE 2  
ESTIMATED FELDSPAR PRODUCTION IN THE UNITED STATES<sup>1</sup>

(Thousand metric tons and thousand dollars)

Year	Flotation concentrate		Other <sup>2</sup>		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
2016	80	6,860	390	26,300	470	33,100
2017	60	3,860	380	23,900	440	27,800

<sup>1</sup>Table includes data available through July 1, 2019. Quantity data are rounded to two significant digits, and value data are rounded to three significant digits; may not add to totals shown.

<sup>2</sup>Includes hand-cobbed feldspar, feldspar content of feldspar-quartz mixtures, and aplite; excludes nepheline syenite.

TABLE 3  
U.S. PRODUCERS OF FELDSPAR IN 2017

Company	Location	Product
APAC-Central, Inc.	Muskogee, OK	Feldspar-quartz mixture.
G3 Enterprises Inc.	Byron, CA	Do.
Graniterock Co.	Felton, CA	Do.
Pacer Corp.	Custer, SD	Potassium feldspar.
Quartz Corp., The	Spruce Pine, NC	Sodium-potassium feldspar.
Do.	do.	Sodium-potassium feldspar; feldspar-quartz mixture.
Unimin Corp.	Emmett, ID	Feldspar-quartz mixture.
Do.	Spruce Pine, NC	Sodium-potassium feldspar.
Do.	do.	Sodium-potassium feldspar; feldspar-quartz mixture.
U.S. Silica Holdings, Inc.	Montpelier, VA	Aplite.
Do., do. Ditto.		

TABLE 4  
ESTIMATED FELDSPAR SOLD OR USED BY PRODUCERS IN  
THE UNITED STATES, BY USE<sup>1,2</sup>

(Thousand metric tons and thousand dollars)

Use	2016		2017	
	Quantity	Value	Quantity	Value
Glass <sup>3</sup>	300	20,700	290	16,700
Ceramics/pottery and miscellaneous	170	12,500	150	11,100
Total	470	33,100	440	27,800

<sup>1</sup>Table includes data available through July 1, 2019. Quantity data are rounded to two significant digits, and value data are rounded to three significant digits; may not add to totals shown.

<sup>2</sup>Includes hand-cobbed feldspar, flotation-concentrate feldspar, feldspar in feldspar-quartz mixtures, and aplite.

<sup>3</sup>Includes container glass, fiberglass, and other glass.

TABLE 5  
U.S. EXPORTS OF FELDSPAR, BY COUNTRY OR LOCALITY<sup>1</sup>

(Metric tons and dollars)

Country or locality	2016		2017	
	Quantity	Value <sup>2</sup>	Quantity	Value <sup>2</sup>
Brazil	9	2,840	--	--
Canada	2,030	666,000	4,090	819,000
Colombia	637	106,000	417	122,000
Costa Rica	80	21,900	160	51,400
El Salvador	--	--	178	47,600
French Polynesia	7	6,380	7	6,800
Honduras	140	41,200	--	--
Japan	--	--	214	64,000
Korea, Republic of	18	12,900	--	--
Malaysia	18	9,600	18	9,600
Mexico	36	6,820	1	4,580
Panama	180	69,800	240	78,600
Trinidad and Tobago	69	14,200	19	3,320
Venezuela	2,670	565,000	--	--
Total	5,890	1,520,000	5,340	1,210,000

-- Zero.

<sup>1</sup>Table includes data available through July 1, 2019. Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Free alongside ship value.

Source: U.S. Census Bureau.

TABLE 6  
U.S. IMPORTS FOR CONSUMPTION OF FELDSPAR, BY COUNTRY OR LOCALITY<sup>1,2</sup>

(Metric tons and dollars)

Country or locality	2016		2017	
	Quantity	Value <sup>3</sup>	Quantity	Value <sup>3</sup>
Brazil	103	54,100	81	47,700
Canada	4	2,000	--	--
Germany	520	161,000	437	145,000
India	536	142,000	272	62,400
Japan	--	--	1	7,200
Malawi	1	450	--	--
Mexico	671	187,000	622	165,000
Spain	927	253,000	617	179,000
Turkey	34,200	2,630,000	288,000 <sup>4</sup>	6,880,000 <sup>4</sup>
United Kingdom	--	--	20	14,100
Total	36,900	3,430,000	290,000	7,500,000

-- Zero.

<sup>1</sup>Table includes data available through July 1, 2019. Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Excludes nepheline syenite (mostly from Canada), which is listed in table 1.

<sup>3</sup>Customs value.

<sup>4</sup>Referred to the U.S. Census Bureau for verification.

Source: U.S. Census Bureau as adjusted by U.S. Geological Survey.



TABLE 7  
FELDSPAR: WORLD PRODUCTION, BY COUNTRY OR LOCALITY<sup>1</sup>

(Metric tons)

Country or locality <sup>2</sup>	2013	2014	2015	2016	2017
Algeria	259,000	230,372	245,000	240,000	240,000
Argentina	219,666 <sup>r</sup>	162,854 <sup>r</sup>	186,974 <sup>r</sup>	155,217 <sup>r</sup>	170,000 <sup>e</sup>
Australia, includes nepheline syenite <sup>e</sup>	45,000	45,000	45,000	10,000 <sup>r</sup>	10,000
Austria <sup>e</sup>	35,000	35,000	35,000	35,000 <sup>r</sup>	35,000
Brazil, beneficiated, marketable	294,357	418,000 <sup>e</sup>	420,000 <sup>e</sup>	400,000 <sup>e</sup>	400,000
Chile	3,874	4,233	6,577	6,352 <sup>r</sup>	5,000 <sup>e</sup>
China	3,500,000 <sup>e</sup>	3,670,000 <sup>e</sup>	3,820,000 <sup>r</sup>	3,800,000	4,000,000 <sup>e</sup>
Cuba	3,200 <sup>e</sup>	3,600 <sup>e</sup>	3,300 <sup>e</sup>	3,900	3,500
Czechia	411,000	422,000	433,000	454,000	460,000
Ecuador	210,000 <sup>e</sup>	183,000 <sup>e</sup>	253,000 <sup>e</sup>	148,506 <sup>r</sup>	190,000 <sup>e</sup>
Egypt	400,000 <sup>e</sup>	400,000 <sup>e</sup>	421,000 <sup>e</sup>	400,000	400,000 <sup>e</sup>
Ethiopia <sup>e</sup>	550	596	600	600	600
Finland	47,636	46,233	38,026	18,549 <sup>r</sup>	25,000 <sup>e</sup>
Germany <sup>e</sup>	200,000	200,000	200,000	200,000	200,000
Greece	--	--	--	--	--
Guatemala	19,611	10,410	10,340	30,428 <sup>r</sup>	20,000 <sup>e</sup>
India	1,224,773	1,634,240	1,400,000 <sup>e</sup>	1,500,000 <sup>e</sup>	1,500,000 <sup>e</sup>
Iran	1,313,233	1,128,569	1,003,354	750,000 <sup>e</sup>	1,000,000
Italy	4,700,000 <sup>e</sup>	4,700,000 <sup>e</sup>	4,500,000 <sup>e</sup>	4,000,000	3,500,000
Kenya	--	--	--	3 <sup>r</sup>	-- <sup>e</sup>
Korea, Republic of	343,241	528,958	601,030	654,398 <sup>r</sup>	600,000 <sup>e</sup>
Macedonia	15,168	18,076	20,289	19,919	21,237
Malaysia	314,399	378,446	442,980	326,648	350,000
Mexico	164,484	150,726	159,372	122,176 <sup>r</sup>	130,000
Morocco	45,000 <sup>e</sup>	45,000 <sup>e</sup>	45,000 <sup>e</sup>	40,000	40,000
Nigeria	12,880	60,580 <sup>r</sup>	47,000 <sup>r</sup>	34,144	27,660
Norway	--	154,000	76,000	50,000	50,000 <sup>e</sup>
Pakistan <sup>3</sup>	77,134	38,126	141,582	305,308	160,999
Peru	22,695	18,019	16,979	16,629	14,929
Philippines	30,388	34,232	38,067	30,000 <sup>r,e</sup>	40,000 <sup>e</sup>
Poland, processed, including imported material	513,000 <sup>r</sup>	519,900	539,900	500,000 <sup>r</sup>	500,000 <sup>e</sup>
Portugal	70,057	70,865	93,789	132,105	126,211
Romania	6,800 <sup>e</sup>	9,200 <sup>e</sup>	9,100 <sup>r,e</sup>	9,000 <sup>r</sup>	8,000 <sup>e</sup>
Russia	390,000 <sup>e</sup>	400,000 <sup>e</sup>	400,000 <sup>e</sup>	400,000	300,000 <sup>e</sup>
Saudi Arabia	160,000	168,000	179,000 <sup>r</sup>	188,000 <sup>r</sup>	197,000
Slovakia	5,000 <sup>e</sup>	6,000 <sup>e</sup>	4,000	8,400 <sup>r</sup>	6,000 <sup>e</sup>
South Africa	191,443	102,541	130,184	131,023	124,795
Spain, includes pegmatite	592,908	533,328	558,273	634,519	600,000 <sup>e</sup>
Sri Lanka, crude and ground	96,000 <sup>e</sup>	96,000 <sup>e</sup>	96,000 <sup>e</sup>	95,000	90,000 <sup>e</sup>
Sudan	31,700	50,680	94,354	92,172	26,912
Sweden, crude and ground, marketable <sup>e</sup>	30,000	27,000	27,000	16,000 <sup>r</sup>	20,000
Thailand	1,072,656	1,413,428	1,331,916	1,167,147 <sup>r</sup>	1,385,925
Turkey	4,545,198 <sup>r</sup>	5,092,560 <sup>r</sup>	6,368,079 <sup>r</sup>	6,120,978 <sup>r</sup>	7,153,908
Ukraine	134,000	94,506	44,460	40,000 <sup>r,e</sup>	40,000 <sup>e</sup>
United States <sup>e,4,5</sup>	550,000	530,000	520,000	470,000	440,000
Venezuela	91,100	93,900	75,500	80,000 <sup>e</sup>	80,000 <sup>e</sup>
Total	22,400,000	23,900,000 <sup>r</sup>	25,100,000 <sup>r</sup>	23,800,000 <sup>r</sup>	24,700,000

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

<sup>1</sup>Table includes data available through October 11, 2018. All data are reported unless otherwise noted. Totals 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, Bulgaria, Burma, Colombia, France, Namibia, the United Arab Emirates, and Yemen may have produced feldspar, but available information was inadequate to make reliable estimates of output.

<sup>3</sup>Production is based on fiscal year, with a starting date of June 30 of the year shown.

<sup>4</sup>Rounded to two significant digits to avoid disclosing company proprietary data.

<sup>5</sup>Includes hand-cobbed feldspar, flotation-concentrate feldspar, feldspar in feldspar-quartz mixtures, and aplite.