



2010 Minerals Yearbook

FELDSPAR AND NEPHELINE SYENITE

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By Arnold O. Tanner

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In 2010, feldspar production in the United States was estimated at nearly 550,000 metric tons (t) valued at \$33.5 million, down from \$35.6 million in 2009, based upon a combination of reported and estimated U.S. Geological Survey (USGS) data. Exports of feldspar in 2010 more than doubled to 16,800 t valued at \$2.78 million, and imports of feldspar decreased by 3% to 2,050 t valued at \$503,000. Imports of nepheline syenite (predominantly from Canada) increased by 20% to 368,000 t valued at slightly more than \$52 million. World production of feldspar was estimated to be nearly 21 million metric tons (Mt) (tables 1, 7).

Apparent consumption of feldspar and imported nepheline syenite combined was slightly more than 1 Mt, primarily for use in the glass and ceramics industries and also as fillers in various products such as paints and coatings. Data on feldspar include silica producers that produce feldspar-quartz mixtures and one U.S. producer of aplite, a rock in which quartz and feldspar are the dominant minerals. Because domestic nepheline syenite production was consumed for use as roofing granules and in other construction applications (excluding ceramics, glass, and filler applications) the data were not included in this chapter. Trade data in this report are from the U.S. Census Bureau.

Feldspar

Production.—Feldspar was mined in seven States. These were, in descending order of estimated output, North Carolina, Virginia, California, Idaho, Georgia, Oklahoma, and South Dakota. North Carolina accounted for more than 40% of the total. Data on domestic production and sales and use of feldspar in this report are based upon data collected by the USGS by means of a voluntary survey. Nine companies mined feldspar and operated 12 beneficiation facilities—4 in North Carolina, 3 in California, and 1 in each of the 5 remaining States (table 3). Of these beneficiation facilities, eight responded to the canvass, representing about 70% of the 2010 production tonnages listed in tables 1 and 2, comparable with that of 2009. Production for the remaining operations was estimated from prior-year output levels.

Consumption.—Feldspar is used in the manufacture of glass and ceramics, and as a filler and extender in paint, plastics, and rubber. Of the domestic feldspar sold or used, an estimated two-thirds by tonnage went into the manufacture of glass, including glass containers, flat glass, glass fiber for home insulation, and specialty glass. In glassmaking, feldspar fluxes the system—lowering the melting temperature and helping promote the mixing of the melt components. The alumina from feldspar increases viscosity, inhibits devitrification, and acts as a stabilizer to improve product hardness, durability, and resistance to chemical corrosion. In ceramics, the alkalis (calcium, potassium, and sodium ions) in feldspar act as a flux, working with soda ash to lower the melting temperature of a mixture,

as in glassmaking. Feldspar melts at an early stage in the firing process, forming a glassy phase or matrix in which the alkalis help to lower the melting temperature and soften the small crystalline and glassy components of the system and promote an increased fusing of the same (Roskill Information Services Ltd., 2008, p. 200). Pottery (including electrical insulators, sanitaryware, tableware, and tile) and other uses, such as fillers, accounted for the remainder of the feldspar consumed (table 4). The value of total feldspar sold or used listed in table 4 is higher than the feldspar production value listed in tables 1 and 2 because table 4 values represent the final marketed feldspar products.

The glass container industry in North America was moderately stable with regard to sales, although some container types, such as baby food, fruit juices, mineral water, and wine, and a recent trend to import less expensive containers from China, provided increasing competition for glass, and thus with its traditional raw materials. Cullet, especially from post-consumer “bottle-to-bottle” recycling programs, also competed with these raw materials. In late 2010, the North American glass container industry, with the goal of 50% recycled content by 2013, released its first comprehensive life cycle assessment (LCA) of glass used in glass packaging. The LCA enumerated several benefits achieved from increasing the amount of cullet in glass container production, including decreased primary energy costs, reduced greenhouse gas emissions, and extended life of glass manufacturing furnaces. Cullet use also decreased the demand for raw materials, including feldspar (Cattaneo, 2011).

The construction industry was a major consumer of products in which feldspar was one of the primary raw materials. In the United States, construction starts for new privately owned housing rose to 587,000 units in 2010, up from 554,000 units in 2009, although still notably lower than the 906,000 units started in 2008. Conversely, housing completions decreased to 650,000 units in 2010 from 790,000 units in 2009 and from 1.1 billion units in 2008 (U.S. Census Bureau, 2011a, b). Shipments of domestic tile increased to 60 million square meters (Mm²), up nearly 14% in 2010 from that of 2009, the highest since 2005 when 61 Mm² were shipped (Whitmire, 2011).

World Review.—Feldspar was produced in more than 50 countries, with significant and potentially economic deposits of feldspar occurring in at least 70 countries. Turkey appears to have been the leading producing country with an estimated 5 Mt of feldspar in 2010, followed by Italy, with an estimated 4.7 Mt. China’s production was estimated to be about 2.1 Mt. World production increased by an estimated 0.8 Mt to 20.6 Mt (table 7).

Recovery from the worldwide economic recession of 2008 and early 2009 for feldspar’s two major consumer industries, glass and

ceramics, continued in 2010. Ceramic tile production increased in Brazil, China, and India. Exports of ceramic tile from China, the world's leading exporter, continued to increase, although China's tile industry was substantially more dependent upon domestic consumption than exports. In Brazil and India, where ceramic industries depend on domestic consumption, significant increases in construction continued, resulting in increased domestic sales of ceramic tiles. Production of sanitaryware, to which feldspar is especially important in the firing process, increased significantly in China, Mexico, the Middle East, South America, and South East Asia, but decreased in Western Europe and the United States (Hao and Wilson, 2011).

European Union.—At the request of the European Ceramic Tile Manufacturers Federation (ECTMF) in 2010, the European Union (EU) launched an antidumping probe of imported ceramic tiles from China to determine whether low-valued Chinese imports had caused injury to the EU's ceramic tile industry. Depending on the results of the investigation to be completed within 15 months, antidumping duties could be assessed against Chinese imports in the EU for as long as 5 years, with individual EU governments determining whether to impose the duties (China International Publishing Group, 2010).

China.—As the world's leading producer and consumer of ceramic tiles, China increased production of sanitaryware by 11% in 2010 from that of 2009 to an annual output of 174 million pieces, of which 47% was produced in Henan Province. This represents nearly 40% of global production (Hao and Wilson, 2011). According to the China Ceramic Industry Association, exports of tiles and other construction-related ceramic products increased by 10% in 2010 from that of 2009; a trend that was expected to continue. In China's ceramics industry, feldspar prices increased 22% to 30% since 2008 owing to an increasing shortage of domestic raw material and increased energy and labor costs. Some prices rose to as much as \$150 per metric ton, depending on the quality (Feytis, 2011a).

Greece.—Feldspar, typically sodium feldspar from pegmatites, is mined mostly in the northeastern part of the country. About 23,000 metric tons per year (t/yr) is produced for use in sanitaryware and glassware for domestic use and export. The Greek ceramic industries, particularly floor and wall tiles and sanitaryware, consume about 40,000 t/yr of feldspar, the largest portion of needed imports coming from the EU, especially from Turkey.

Mevoir Co. SA (majority owned by Ankerpoort, a subsidiary of the Sibelco Group) mined pegmatites rich in sodium feldspar in the area of Karteres Thessaloniki. About one-half of Mevoir's production supplied domestic industries and the remainder was exported to the Czech Republic, Germany, and Italy. Filceram Johnson Co. SA mined feldspar in Platanochori Chalkidiki and typically consumed 30,000 t/yr of coarse-grained (0–6 millimeters) material for floor and wall tiles. The company suspended operations at yearend, likely for financial reasons (Tsirambides and Filippidis, 2012).

Italy.—Ranked as the world's second leading feldspar producer in 2010 with an estimated 4.7 Mt of production; most of Italy's output was used in the country's ceramics industry. Italy exported about 195,000 t of feldspar and imported nearly 2 Mt, more than 1.8 Mt of which was from Turkey (United

Nations Statistics Division, undated a). Ceramic tile production, the Italian ceramic industry's leading sector, increased by 5% in volume and sales increased slightly in 2010 compared with those of 2009 (Ceramics of Italy, 2011). According to the Association of Italian Manufacturers of Machinery and Equipment for Ceramics, the sector exported more than 75% of its production, benefitting especially from growth in Asia, the Middle East, and South America (Feytis, 2011b).

Norway.—Sibelco Nordic (formerly North Cape Minerals AS) announced plans to close its pegmatite mine in Glamsland in 2011, a principal source of feldspar for the company's Lillesand feldspar/quartz plant. The closure was prompted by expensive processing costs and falling demand for feldspar in traditional cathode-ray tube television sets since the development of flat panel (liquid crystal display and plasma) televisions. The Lillesand plant was to continue feldspar production at the Fossbekk branch of the plant (Feytis and others, 2010).

Turkey.—Turkey, the world's leading feldspar producer in 2010, produced an estimated 5 Mt, of which about 3.7 Mt was exported; about two-thirds of the exports went to Italy and Spain (United Nations Statistics Division, undated a). Feldspar was mined in the southeast part of the country and exported to major ceramic manufacturing countries throughout Europe.

Nepheline Syenite

Production.—No nepheline syenite was produced in the United States for ceramic, glass, or filler use. Nepheline syenite with high iron content, however, was produced in Arkansas for use in roofing granules, road materials, asphalt and concrete aggregate, and related products.

Consumption.—In glass and ceramics manufacture, nepheline syenite, like feldspar, provides alkalis that act as a flux. In glass, nepheline syenite also supplies alumina, imparting the same benefits as feldspar.

World Review.—Nepheline syenite is produced in Brazil, Canada, China, Norway, Russia, and Turkey for feldspathic uses.

Canada.—Canada's sole nepheline syenite producer, Unimin Canada, Ltd., operated two plants at its Blue Mountain and Nephton, Ontario, deposits, about 175 kilometers northeast of Toronto. Production of marketable nepheline syenite was estimated to be about 580,000 t in 2010 (Natural Resources Canada, 2012). Detailed end-use data have not been available in recent years, but historically, the material had been consumed in glass, ceramics, filler, and abrasives markets. Total Canadian nepheline syenite exports were about 454,000 t in 2010, most of which went to the United States, 368,000 t; Italy, 42,000 t; and Spain, 21,000 t (United Nations Statistics Division, undated b).

China.—Hong Kong-based Finetion Industrial Minerals Ltd. produced about 50,000 t of nepheline syenite in 2010 at its plant in Anyang, Henan Province, to supply the ceramics, glass, and paint filler markets in China and other Asian markets. Previously, the company mostly exported to ceramic industries in Italy and Spain, but a decline in demand in those countries and increased freight rates resulted in lower exports to Europe. Finetion announced construction of a new 50,000-t/yr nepheline syenite

plant in southern China to be completed in mid-2011 at its deposit in northern Guangdong Province (Industrial Minerals, 2010).

Norway.—Sibelco Nordic produces nepheline syenite during the summer and autumn from an open pit on the Arctic Island of Stjernoy. Processing of the ore, including crushing, drying, milling, sieving, magnetic separation, and air classification was performed on Stjernoy to produce different product sizes for the glass, ceramic, and paint industries. Data for 2010 were unavailable but output for 2009 was estimated to be 350,000 t. In 2010, total nepheline syenite exports from Norway were about 330,000 t, with Poland receiving about 79,000 t; the Netherlands, 77,000 t; Germany, 54,000 t; the United Kingdom, 41,000 t; Spain, 22,000 t; France, 15,000 t; and Portugal, 10,000 t; and the remainder to several other countries (United Nations Statistics Division, undated b).

Outlook

Producers of feldspar and nepheline syenite faced continuing challenges in 2011 and into the future related to excess supply and increased production costs that include motor fuels, natural gas and electric power, processing chemicals, and regulatory compliance. Higher transportation charges for shipping feldspathic products by rail and truck in 2012 likely will continue to increase delivered raw material costs to industrial consumers.

According to the Freedonia Group, U.S. glass food container demand is expected to rise modestly during the next several years, increasing feldspar consumption by glass container manufacturers. The use of glass containers in the United States may increase in the future as a result of consumer demand and Federal Government and State government initiatives for environmentally friendly and recyclable food and beverage packaging. However, increases in glass container recycling could reduce the need for raw materials to manufacture these containers.

The decreased use of flat glass during the past several years because of declines in the automobile and construction industries moderated in 2010, especially with an expansion of automobile production. Manufacturing of light vehicles in North America increased by 39% in 2010 compared with that of 2009, and in the United States, increased by 35% to 7.58 million units in 2010 from 5.61 million units in 2009. In the long-term, growth is expected (IHS Automotive Inc., 2011). When economic conditions improve, new residential construction and commercial and residential remodeling is expected to increase in 2011 and 2012, creating increased demand for glass and ceramics and thus feldspar.

Globally, ceramics industry growth significantly slowed during the 2008–09 recession, and with it, the use of feldspar. It is anticipated that the ceramic industry will rebound in the next few years. The main centers of ceramic production are China, India, Italy, Latin America, and Southeast Asia. Although consuming much of its own output, China is likely to continue as an important exporter of ceramic tile. Owing to continued recovery in the construction sector, increased demand for feldspar and associated raw materials is likely to follow. Innovative ideas and products in ceramics, such as thinner and stronger ceramic sheets that can be laid over existing tiled floors without the need for removal, and porcelain tiles that offer superior physical and chemical characteristics, are likely to help strengthen that

sector. The main growth in feldspar demand is expected to be in Southeast Asia, China, Eastern Europe, India, and South America, potentially representing an average annual growth rate of about 5% (Roskill Information Services Ltd., 2008; Feytis, 2010).

Fiberglass consumption in the United States is forecast to increase as residential and commercial construction and resultant construction materials consumption increases by as much as 3% per year by 2013. This growth will be driven by efforts to reduce costs and broaden markets, with best growth prospects anticipated for glass wool fiber (O'Driscoll, 2009).

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TABLE 1
 SALIENT FELDSPAR AND NEPHELINE SYENITE STATISTICS¹

		2006	2007	2008	2009	2010
United States:						
Produced, feldspar:						
Quantity ^{e, 2, 3}	thousand metric tons	760	730	650	550	550
Value ^{e, 2}	thousands	\$44,600	\$43,800	\$40,000	\$35,600	\$33,500
Exports, feldspar: ⁴						
Quantity	metric tons	10,400	9,980	14,600	7,520	16,800
Value ⁵	thousands	\$1,930	\$1,950	\$2,390	\$1,150	\$2,280
Imports for consumption ⁴						
Feldspar:						
Quantity	metric tons	5,180	3,570	2,030	2,120	2,050
Value ⁶	thousands	\$549	\$642	\$646	\$646	\$503
Nepheline syenite:						
Quantity	metric tons	426,000	391,000	321,000	308,000	368,000
Value ⁶	thousands	\$36,000	\$38,900	\$35,000	\$36,800	\$52,400
Consumption, apparent ^{e, 7}	thousand metric tons	1,180	1,120	957	856	899
World, production ⁸	do.	20,600 ^r	21,500	22,700 ^r	19,600 ^r	20,500 ^e

^eEstimated. ^rRevised. do. Ditto.

¹Data are rounded to no more than three significant digits.

²Includes hand-cobbed feldspar, flotation-concentrate feldspar, feldspar in feldspar-quartz mixtures, and aplite; may differ from sales in table 4.

³Rounded to two significant digits.

⁴Source: U.S. Census Bureau.

⁵Free alongside ship (f.a.s.) value.

⁶Customs value.

⁷Production plus imports minus exports. Includes feldspar and nepheline syenite.

⁸Feldspar only.

TABLE 2
 ESTIMATED FELDSPAR PRODUCTION IN THE UNITED STATES¹

(Thousand metric tons and thousand dollars)

Year	Flotation concentrate		Other ²		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
2009	210	13,600	340	22,000	550	35,600
2010	170	11,900	380	21,600	550	33,500

¹Quantity data are rounded to two significant digits, and value data are rounded to three significant digits; may not add to totals shown.

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

TABLE 3
U.S. PRODUCERS OF FELDSPAR IN 2010

Company	Location	Product
APAC-Arkansas, Inc.	Muskogee, OK	Feldspar-quartz mixture.
Feldspar Corp.,The	Monticello, GA	Potassium feldspar.
Do.	Spruce Pine, NC	Sodium-potassium feldspar.
Graniterock Co.	Felton, CA	Feldspar-quartz mixture.
Kings Mountain Minerals Inc.	Kings Mountain, NC	Do.
K-T Feldspar Corp.	Spruce Pine, NC	Sodium-potassium feldspar; feldspar-quartz mixture.
Pacer Corp.	Custer, SD	Potassium feldspar.
P.W. Gillibrand Co. Inc.	Simi Valley, CA	Feldspar-quartz mixture.
Unimin Corp.	Byron, CA	Do.
Do.	Emmett, ID	Do.
Do.	Spruce Pine, NC	Sodium-potassium feldspar.
U.S. Silica Co.	Montpelier, VA	Aplite.
Do. Ditto.		

TABLE 4
ESTIMATED FELDSPAR SOLD OR USED BY PRODUCERS
IN THE UNITED STATES, BY USE^{1,2}

(Thousand metric tons and thousand dollars)

Use	2009		2010	
	Quantity	Value	Quantity	Value
Glass ³	360	23,200	330	111,000
Pottery and miscellaneous	200	14,400	220	13,100
Total	550	37,600 ⁴	550	124,000 ⁴

¹Includes hand-cobbed feldspar, flotation-concentrate feldspar, feldspar in feldspar-quartz mixtures, and aplite.

²Quantity data are rounded to two significant digits, and value data are rounded to three significant digits; may not add to totals shown.

³Includes container glass, glass fiber, and other glass.

⁴Represents final marketable product; value is higher than that listed for production in tables 1 and 2.

TABLE 5
U.S. EXPORTS OF FELDSPAR, BY COUNTRY¹

(Metric tons and dollars)

Country	2009		2010	
	Quantity	Value ²	Quantity	Value ²
Brazil	--	--	134	35,100
Canada	880	230,000	1,260	356,000
China	14	13,200	151	82,500
Colombia	2,160	522,000	1,100	354,000
Ecuador	17	2,700	1,330	221,000
Norway	3,520	220,000	10,200	855,000
Russia	--	--	2,130	226,000
Trinidad and Tobago	464	70,400	179	52,200
Other (27 countries)	459 ^r	92,000 ^r	302	94,900
Total	7,520	1,150,000	16,800	2,280,000

^rRevised. -- Zero.

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

²Free alongside ship value.

Source: U.S. Census Bureau.

TABLE 6
U.S. IMPORTS FOR CONSUMPTION OF FELDSPAR, BY COUNTRY^{1, 2}

(Metric tons and dollars)

Country	2009		2010	
	Quantity	Value ³	Quantity	Value ³
Australia	3	2,340	--	--
Germany	836	371,000	516	201,000
Mexico	1,240	252,000	1,530	302,000
United Kingdom	40	19,800	--	--
Total	2,120	646,000	2,050	503,000

-- Zero.

¹Excludes nepheline syenite (mostly from Canada), which is listed in table 1.

²Data are rounded to no more than three significant digits; may not add to totals shown.

³Customs value.

Source: U.S. Census Bureau.

TABLE 7
FELDSPAR: WORLD PRODUCTION, BY COUNTRY^{1,2}

(Metric tons)

Country and grade ³	2006	2007	2008	2009	2010 ^c
Argentina	170,728	291,562	220,234	213,671	215,000
Australia, includes nepheline syenite ^c	50,000	50,000	50,000	50,000	50,000
Brazil, processed, marketable	77,285	166,089 ^r	121,952 ^r	115,264 ^r	115,000 ^p
Bulgaria ^c	93,091 ⁴	90,000	90,000	80,000 ^r	80,000
Chile	5,847	6,704	17,834	9,079	10,000
China ^c	1,950,000	2,000,000	2,000,000	2,000,000	2,100,000
Colombia ^c	86,000	91,000	86,000	85,000	85,000
Cuba ^c	5,500	5,600	4,300	4,700 ^r	4,700
Czech Republic	487,000	514,000	488,000	431,000	388,000
Ecuador ^c	67,844 ⁴	14,308 ⁴	14,000	10,000	10,000
Egypt	360,000 ^e	135,290	407,320	353,623	355,000
Ethiopia ^c	478	459	424	199 ^r	300
Finland	56,263	48,890 ^r	45,250 ^r	45,000 ^r	45,000
France, crude ^c	650,000	650,000	650,000	650,000	650,000
Germany	167,332	171,303	161,416	106,837 ^r	150,000
Greece ^c	95,000	95,000	62,000 ⁴	28,617 ⁴	30,000
Guatemala	17,176	30,234	45,854	5,762	10,000
India	466,422 ^r	486,472 ^r	385,436 ^r	390,000 ^e	400,000
Iran ^c	290,000	512,261 ⁴	501,821 ⁴	500,000	500,000
Italy ^e	4,019,495 ⁴	4,200,000	4,727,000 ⁴	4,700,000	4,700,000
Japan, includes aplite ^c	800,000	750,000	700,000	700,000	650,000
Jordan	11,054	9,800	2,950	--	--
Kenya ^c	25	30	30	30	30
Korea, Republic of	427,378	398,513	344,257	622,700	600,000
Macedonia	32,824	32,814	28,920	19,377	20,000
Malaysia	142,358	358,775	457,377	356,620	360,000
Mexico	459,209	438,696	445,519	347,510 ^r	398,849 ⁴
Morocco ^c	20,000	20,000	20,000	20,000	20,000
Nigeria ^c	1,700	1,700	1,700	13,631 ⁴	10,000
Norway ^c	65,000 ^r	65,000 ^r	62,000 ⁴	48,000	48,000
Pakistan	15,085	13,236 ^r	12,000 ^r	10,000 ^r	11,000
Peru	6,010 ^e	15,450	13,333 ^r	5,006	3,589 ⁴
Philippines	15,176	14,837	15,838	16,394	17,000
Poland, run of mine ⁵	431,300	497,900	599,100	445,500 ^r	450,000
Portugal	257,570	168,606	157,359	320,000	315,000 ^p
Romania ^{e,6}	33,000 ^r	45,000 ^r	25,000 ^r	14,000 ^r	15,000
Russia ^c	45,000	45,000	45,000	45,000	45,000
Saudia Arabia	42,300	73,000	550,000	500,000 ^e	500,000
Serbia ^c	3,500	3,500	3,500	3,500	3,500
Slovakia ^c	5,000	5,000	5,000	13,000 ⁴	13,000
South Africa	75,400	90,185	105,815	101,394	95,434 ⁴
Spain, includes pegmatite ^c	674,766 ⁴	680,000 ⁴	690,000	550,000	550,000
Sri Lanka	56,864	28,866 ^r	32,586 ^r	35,000 ^r	36,000
Sweden, salable, crude and ground ^c	42,000	42,000	42,000	42,000	42,000
Thailand	1,067,684	684,668	670,618	600,000 ^e	600,000
Turkey	5,771,892	6,548,796	6,767,500	4,212,547	5,000,000
United Kingdom, china stone ^c	2,000	2,000	1,000	1,000	1,000
United States ^{e,6}	760,000	730,000	650,000	550,000	550,000
Uruguay ^c	2,470 ⁴	2,500	2,500	2,500	2,500

See footnotes at end of table.

TABLE 7—Continued
 FELDSPAR: WORLD PRODUCTION, BY COUNTRY^{1,2}

(Metric tons)

Country and grade ³	2006	2007	2008	2009	2010 ⁶
Uzbekistan ^e	4,300	4,300	4,300	4,300	4,300
Venezuela ^e	200,000 ⁴	200,000	200,000	200,000	200,000
Total	20,600,000 ^r	21,500,000	22,700,000 ^r	19,600,000 ^r	20,500,000

^eEstimated. ^pPreliminary. ^rRevised. -- Zero.

¹World totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

²Table includes data available through August 10, 2011.

³In addition to the countries listed, Namibia, the United Arab Emirates, and Yemen may produce feldspar, but output is not officially reported; and available information is inadequate to make reliable estimates of output levels.

⁴Reported figure.

⁵The dedicated feldspar run of mine production accounts for only part of total feldspar production.

⁶Rounded to two significant digits to avoid disclosing company proprietary data.