



# 2006 Minerals Yearbook

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## FELDSPAR AND NEPHELINE SYENITE

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# FELDSPAR AND NEPHELINE SYENITE

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In 2006, U.S. feldspar production, using some estimated data, was 760,000 metric tons (t) valued at \$45 million. Exports of feldspar decreased by 32% to 10,400 t valued at about \$1.9 million, and imports decreased by 80% to 5,180 t valued at \$0.5 million. There was no U.S. production of nepheline syenite for glass and ceramic use, and imports of nepheline syenite (all from Canada) increased by 25% to 426,000 t valued at \$36 million. Apparent consumption of feldspar and nepheline syenite combined was 1.2 million metric tons (Mt). World production of feldspar was about 15 Mt.

This report includes information on feldspar, nepheline syenite, and aplite (one U.S. producer). Trade data in this report are from the U.S. Census Bureau.

## Feldspar

**Production.**—Feldspar was mined in seven States, which were, in descending order of estimated output, North Carolina, Virginia, California, Oklahoma, Georgia, Idaho, and South Dakota. North Carolina accounted for at least 45% of the total. Data on domestic production and sales and use of feldspar were collected by the U.S. Geological Survey (USGS) by means of a voluntary survey. Nine U.S. companies mined feldspar and operated 12 beneficiation facilities—4 in North Carolina, 3 in California, and 1 in each of the 5 remaining States listed above (table 3). Of the 12 known beneficiation facilities, 7 responded with production data by the canvass closeout date. These respondents represented about 63% of the 2006 production tonnages listed in tables 1 and 2. Production for the remaining operations was estimated from prior-year production levels.

Although not at a production stage, i-minerals inc. reported favorable results from comprehensive metallurgical testing on a composite feldspar sample from its Helmer-Bovill property in Latah County, ID. The sample was sent to the Minerals Research Laboratory at North Carolina State University for bench-scale testing including crushing, grinding, flotation, and other steps. Test results yielded a feldspar product compatible with currently available commercial products. Results from this test work will be incorporated into an ongoing feasibility study by SRK Consulting (U.S.), Inc. (Industrial Minerals, 2006d).

**Consumption.**—Feldspar is used in glassmaking, ceramics, and to some extent as a filler/extender in paint, plastics, and rubber. In glassmaking, alumina from feldspar improves product hardness, durability, and resistance to chemical corrosion. In ceramics, the alkalis in feldspar (calcium oxide, potassium oxide, and sodium oxide) act as a flux, lowering the melting temperature of a mixture. Fluxes melt at an early stage in the firing process, forming a glassy matrix that bonds together the other components of the system. The use of feldspar in flatglass appears to be small (Roskill Information Services Ltd., 2002,

p. 184, 206). Of the domestic feldspar sold or used, an estimated 63% by tonnage went into the manufacture of glass, including glass containers and glass fiber. Pottery (including electrical insulators, sanitaryware, tableware, and tile) and other uses, such as fillers, accounted for the remainder (table 4). The value of total feldspar sold or used in table 4 is higher than the feldspar production value listed in tables 1 and 2 because the table 4 value represents the final marketed feldspar product.

U.S. shipments of glass containers, the leading end use of feldspar, decreased by 2% in 2006 (U.S. Census Bureau, 2007a). Feldspar use also was reflected in glass fiber for home insulation, sanitaryware, and tile. New U.S. housing starts were 1.8 million, which was 13% lower than in 2005 (U.S. Census Bureau, 2007b). By contrast, the U.S. feldspar produced and sold or used in 2006 in tables 1, 2, and 4 indicates a slight increase compared with that of 2005. This anomaly may be the result of using some estimated data in the U.S. production and sold-or-used figures.

Florida Tile Industries Inc. was acquired by the Italian company Panariagroup Industrie Ceramiche SpA in early 2006. In July, Florida Tile broke ground for a new \$20 million porcelain tile factory in Lawrenceburg, KY. In June, the Italy-based Marazzi Group announced plans to invest \$50 million in an expansion to double the capacity of its tile plant in Dallas, TX (Grahl, 2006b; Industrial Minerals, 2006e).

**Foreign Trade.**—U.S. feldspar exports were 10,400 t in 2006, similar to the average of the previous 4 years (table 6). U.S. imports of feldspar were 5,200 t, similar to pre-2004 levels (table 7). Turkey supplied material in 2004 and 2005 but not in 2006. Feldspar from Turkey for those 2 years increased total imports to the 20,000- to 25,000-metric-ton-per-year (t/yr) range.

**World Review.**—Feldspar was produced in more than 50 countries (table 8). Italy was the leading producing country with an estimated 3 Mt of feldspathic materials in 2006, followed by Turkey with 2.3 Mt. Japan had an estimated production of 1 Mt of feldspathic minerals, including altered granite, aplite, pegmatitic feldspar, and roseki, which is a type of china stone (partly decomposed granite). Thailand had an estimated production of 1 Mt; output was largely sodium feldspar. Although official production data were not available, China has been estimated, by some sources, to have an output of 1 to 2 Mt annually (Roskill Information Services Ltd., 2002, p. 46, 90, 136).

**Australia.**—Monto Minerals Ltd. continued with construction and development of its Goondicum ilmenite, feldspar, apatite, and titanomagnetite project in central Queensland. Plans called for construction of a water pipeline and powerline to the project. Key products were to include feldspar for glassmaking, industrial abrasives, and paints. Commercial production was

targeted to begin in the second half of 2007 (Industrial Minerals, 2006c; Monto Minerals Ltd., 2007).

**Germany.**—Eczacıbaşı Group, a leading Turkish industrial group, acquired ceramic tile producer Engers Keramik GmbH & Co. for an estimated \$24 million. Engers has a tile production capacity of 2.3 million square meters per year. Eczacıbaşı is a leading manufacturer of sanitaryware and has a 13% share of the German market (Industrial Minerals, 2006b).

**New Zealand.**—In Christchurch, Terranova (formerly known as the Recovered Materials Foundation) developed a glass crushing and screening plant to handle recycled bottles. Current crushing capacity is 750 to 1,000 t/yr of bottle glass. At present, up to 80% of the end product was being used as sandblasting material, and 15%, for water filtration media in swimming pools. Other potential markets being looked at included glassphalt (crushed glass mixed with asphalt for roads), glass tiles, gray water filtration (such as in sewage farm filter beds), and other uses (Industrial Minerals, 2006a).

## Nepheline Syenite

In glass and ceramics manufacture, nepheline syenite, like feldspar, provides alkalis that act as a flux to lower the melting temperature of a glass or ceramic mixture, prompting faster melting and fuel savings. In glass, nepheline syenite also supplies alumina, which gives improved thermal endurance, increased chemical durability, and increased resistance to scratching and breaking.

**World Review.**—Canada and Norway produced nepheline syenite for glass and ceramic use.

**Canada.**—Canada's sole nepheline syenite producer, Unimin Canada, Ltd., operated two plants at its Blue Mountain, Ontario, deposit, about 175 kilometers northeast of Toronto. Production of marketable nepheline syenite was an estimated 720,000 t in 2006. Detailed end-use data in recent years have not been available, but historically, end uses have been in glass, ceramics, and pigments and fillers. Total nepheline syenite exports were about 534,000 t in 2006. The leading recipients were the United States, 426,000 t; Italy, 58,000 t; and the Netherlands and Spain, 19,000 t each (United Nations Statistics Division, undated).

**Norway.**—North Cape Minerals AS produced nepheline syenite from an underground mine on the arctic island of Stjernoya; output was 320,000 t in 2005 (British Geological Survey, 2007). End-use data for this material have not been available in recent years, but uses in the past have included glass (including amber glass), ceramics, and fillers. In 2006, total exports were 307,000 t. Leading recipients included Poland, 66,000 t; the United Kingdom, 46,000 t; Germany, 43,000 t; Spain, 34,000 t; the Netherlands, 33,000 t; and France, 17,000 t (United Nations Statistics Division, undated).

## Outlook

According to two surveys, a sample of U.S. consumers selected glass containers as their first choice for preserving the quality, purity, and taste of food and beverages. However, a

report from beer manufacturer Anheuser-Busch indicated that aluminum could become a strong choice for beer packaging in the future. Outside the United States, demand for glass containers in a variety of applications is said to be on the rise. This includes such countries as Chile and Peru (Grahl, 2006a).

One trend in U.S. ceramic tile use is said to be in high-end, upscale applications, including bathrooms, despite the soft U.S. housing market. Outside the United States, demand for tile is strong in such areas as Eastern Europe and Russia, which have seen significant ongoing construction activity (Grahl, 2006b).

Sanitaryware has likewise benefited from the current trend to make bathrooms larger and more stylish. One example is the use of high-end bathroom fixtures such as vessel sinks, which are free-standing sinks that sit directly on the countertop or furniture (Kohler Co., undated). However, the slowdown in U.S. housing construction has reduced demand for plumbing fixtures. In other regions, such as China, the active construction market is boosting demand for all building products, including sanitaryware. An example is a variety of new construction projects associated with the 2008 Olympic Games in Beijing (Grahl, 2006b).

The U.S. ceramic dinnerware industry continued to face challenges from changing consumer tastes, pricing pressures, and strong global competition. Consumer tastes are said to have shifted to dinnerware that is more casual than formal dinnerware but still has an aspect of luxury (Grahl, 2006b).

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

		2002	2003	2004	2005	2006
United States:						
Produced, feldspar:						
Quantity <sup>e, 2</sup>	metric tons	790,000	800,000	770,000	750,000 <sup>3</sup>	760,000 <sup>3</sup>
Value <sup>e, 2</sup>	thousands	\$42,800	\$43,400	\$44,000 <sup>3</sup>	\$43,000 <sup>3</sup>	\$45,000 <sup>3</sup>
Exports, feldspar: <sup>4</sup>						
Quantity	metric tons	9,590	8,950	9,630	15,200	10,400
Value <sup>5</sup>	thousands	\$1,370	\$1,310	\$1,420	\$2,070	\$1,930
Imports for consumption: <sup>4</sup>						
Feldspar:						
Quantity	metric tons	5,450	7,980	20,600	26,200	5,180
Value <sup>6</sup>	thousands	\$775	\$1,020	\$944	\$1,700	\$549
Nepheline syenite: <sup>7</sup>						
Quantity	metric tons	333,000	308,000	350,000	340,000	426,000
Value <sup>6</sup>	thousands	\$26,100	\$28,200	\$29,000	\$33,800	\$36,000
Consumption, apparent <sup>e, 8</sup>	thousand metric tons	1,120	1,110	1,130	1,100	1,180
World, production <sup>9</sup>	do.	14,100 <sup>r</sup>	14,300 <sup>r</sup>	14,800 <sup>r</sup>	15,100 <sup>r</sup>	15,400 <sup>e</sup>

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

<sup>1</sup>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; may differ from sales in table 4.

<sup>3</sup>Rounded to two significant digits.

<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>No nepheline syenite produced in the United States for glass and ceramic use.

<sup>8</sup>Production plus imports minus exports. Includes feldspar and nepheline syenite.

<sup>9</sup>Feldspar only.

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
2005	350	19,000	400	23,000	750	43,000
2006	340	19,000	430	25,000	760	45,000

<sup>1</sup>Data are rounded to two significant digits; may not add to totals shown.

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

TABLE 3  
U.S. PRODUCERS OF FELDSPAR IN 2006

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.
Granite Rock Co.	Felton, CA	Feldspar-quartz mixture.
Kings Mountain Mining LLC.	Kings Mountain, NC	Do.
K-T Feldspar Corp.	Spruce Pine, NC	Sodium-potassium feldspar; feldspar-quartz mixture.
Pacer Corp.	Custer, SD	Potassium feldspar.
PW Gillibrand Co.	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.

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	2005		2006	
	Quantity	Value	Quantity	Value
Glass <sup>3</sup>	470	27,000	480	28,000
Pottery and miscellaneous	270	18,000	280	19,000
Total	750	45,000 <sup>4</sup>	760	47,000 <sup>4</sup>

<sup>1</sup>Data are rounded to two 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, glass fiber, and other glass.

<sup>4</sup>Represents final marketable product; value higher than that listed in tables 1 and 2.

TABLE 5  
PRICES FOR U.S. FELDSPAR, YEAREND 2006

(Dollars per metric ton)

	Price <sup>1</sup>
Ceramic grade:	
170 to 200 mesh, sodium	66-83
200 mesh, potassium	138
Glass grade:	
30 mesh, sodium	44-57
80 mesh, potassium	94-99

<sup>1</sup>Bulk, ex-works, United States.

Source: Industrial Minerals, no. 471, December 2006, p. 74.

TABLE 6  
U.S. EXPORTS OF FELDSPAR, BY COUNTRY<sup>1</sup>

(Metric tons and dollars)

Country	2005		2006	
	Quantity	Value <sup>2</sup>	Quantity	Value <sup>2</sup>
Canada	1,030	196,000	1,150	267,000
Colombia	1,410	320,000	1,490	379,000
Costa Rica	2,820	358,000	1,900	264,000
Dominican Republic	128	19,000	300	53,900
Guatemala	306	40,500	549	74,500
Italy	2,350	343,000	1,790	356,000
Mexico	1,100	184,000	639	109,000
Nicaragua	2,210	298,000	2,060	303,000
Panama	3,140	174,000	--	--
Other	725	135,000	477	129,000
Total	15,200	2,070,000	10,400	1,930,000

-- Zero.

<sup>1</sup>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 7  
U.S. IMPORTS FOR CONSUMPTION OF FELDSPAR, BY COUNTRY<sup>1,2</sup>

(Metric tons and dollars)

Country	2005		2006	
	Quantity	Value <sup>3</sup>	Quantity	Value <sup>3</sup>
Mexico	6,030	579,000	5,100	507,000
Turkey	20,000	780,000	--	--
Other	194	343,000	78	41,600
Total	26,200	1,700,000	5,180	549,000

-- Zero.

<sup>1</sup>Excludes nepheline syenite, which is listed in table 1.

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

<sup>3</sup>Customs value.

Source: U.S. Census Bureau.

TABLE 8  
FELDSPAR: WORLD PRODUCTION, BY COUNTRY<sup>1,2</sup>

(Metric tons)

Country <sup>3</sup>	2002	2003	2004	2005	2006 <sup>c</sup>
Argentina	82,642	90,854	125,684 <sup>r</sup>	151,307 <sup>r</sup>	150,000
Australia, includes nepheline syenite <sup>c</sup>	50,000	50,000	50,000	50,000 <sup>r</sup>	50,000
Brazil, processed, marketable	45,194	58,976 <sup>r</sup>	121,452 <sup>r</sup>	122,887 <sup>r</sup>	123,000 <sup>p</sup>
Bulgaria	34,000	35,000	35,000 <sup>c</sup>	35,000	35,000
Burma <sup>c,4</sup>	10,000	10,000	10,000	10,000	10,000
Chile	3,069	6,690	4,838	5,820 <sup>r</sup>	6,000
China <sup>c</sup>	1,600,000	1,700,000	1,800,000	1,850,000	1,900,000
Colombia <sup>c</sup>	93,452 <sup>s</sup>	100,000	100,000	100,000	100,000
Cuba <sup>c</sup>	4,700 <sup>r</sup>	7,200 <sup>r</sup>	10,500 <sup>r</sup>	8,000 <sup>r</sup>	8,000
Czech Republic	401,000 <sup>c</sup>	421,000	488,000 <sup>r</sup>	472,000 <sup>r</sup>	475,000
Ecuador	31,254	44,268	53,469 <sup>r</sup>	38,250 <sup>r</sup>	40,000
Egypt <sup>c</sup>	350,000	350,000	350,000	350,000	350,000
Ethiopia <sup>6</sup>	230 <sup>c</sup>	208	361	445 <sup>r</sup>	478 <sup>s</sup>
Finland	46,715	48,353	57,149	60,000	60,000
France, crude <sup>c</sup>	650,000	650,000	650,000	650,000	650,000
Germany	243,368 <sup>r</sup>	233,028 <sup>r</sup>	182,842 <sup>r</sup>	168,640 <sup>r</sup>	167,332 <sup>s</sup>
Greece <sup>c</sup>	95,000	95,000	95,000	95,000	95,000
Guatemala	11,843	9,320	4,473	3,808 <sup>r</sup>	4,000
India <sup>c</sup>	110,000	150,000	150,000	150,000	160,000
Iran	191,316	242,898	252,713	250,000	250,000
Italy <sup>c</sup>	3,159,000 <sup>r,5</sup>	2,972,000 <sup>r,5</sup>	3,000,000 <sup>r</sup>	3,000,000 <sup>r</sup>	3,000,000
Japan, includes aplite <sup>c</sup>	1,140,000	1,010,000	900,000	1,000,000	1,000,000
Jordan	530	13,057	13,063 <sup>r</sup>	14,000	14,000
Kenya	60 <sup>r</sup>	50 <sup>r</sup>	40 <sup>r</sup>	22 <sup>r</sup>	20
Korea, Republic of	519,125	477,012	541,788	508,644 <sup>r</sup>	500,000
Macedonia <sup>c</sup>	21,000 <sup>s</sup>	21,000	20,000	20,000	20,000
Madagascar <sup>c</sup>	3	3	3	3	3
Malaysia	30,819	42,662	79,220	83,580 <sup>r</sup>	80,000
Mexico	332,101	346,315	364,315	349,109	450,000
Morocco <sup>c</sup>	19,401 <sup>s</sup>	20,000	20,000	20,000	20,000
Nigeria <sup>c</sup>	1,800 <sup>s</sup>	1,800	1,700	1,700	1,700
Norway <sup>c</sup>	75,000	74,000	75,000	76,000	75,000
Pakistan	35,071 <sup>r</sup>	37,344 <sup>r</sup>	30,373 <sup>r</sup>	25,032 <sup>r</sup>	24,000
Peru	6,018	7,349	6,005	6,000 <sup>r</sup>	6,500 <sup>p</sup>
Philippines <sup>c</sup>	30,000	30,000	32,110 <sup>r,5</sup>	11,850 <sup>r,5</sup>	12,000
Poland <sup>7</sup>	293,000	341,400 <sup>r</sup>	300,000 <sup>c</sup>	300,000	300,000
Portugal	124,117 <sup>r</sup>	126,116 <sup>r</sup>	98,262 <sup>r</sup>	133,344 <sup>r</sup>	133,500 <sup>p</sup>
Romania	51,959	71,717	60,924 <sup>r</sup>	56,817 <sup>r</sup>	55,000
Russia <sup>c</sup>	45,000	45,000	45,000	45,000	45,000
Serbia and Montenegro <sup>c,8</sup>	4,500	4,500	4,500	4,000	4,000
Slovakia <sup>c</sup>	4,000	5,000	5,000	5,000	5,000
South Africa	57,197	57,738	53,721 <sup>r</sup>	57,534 <sup>r</sup>	76,000
Spain, includes pegmatite	538,407 <sup>r</sup>	563,580 <sup>r</sup>	552,507 <sup>r</sup>	580,000 <sup>r</sup>	580,000
Sri Lanka	28,866	32,586	33,000 <sup>c</sup>	34,000	35,000
Sweden, salable, crude and ground <sup>c</sup>	40,000	41,000	42,000	43,000	42,000
Thailand	783,733	824,990	1,001,053	1,000,000	1,000,000
Turkey	1,766,387	1,862,310	1,983,336	2,200,000	2,300,000
United Kingdom, china stone	1,896 <sup>r</sup>	2,865 <sup>r</sup>	2,274 <sup>r</sup>	2,500 <sup>r</sup>	2,500
United States	790,000	800,000	770,000	748,000	763,000 <sup>s</sup>
Uruguay	1,550	2,450	2,450 <sup>r</sup>	2,150 <sup>r</sup>	2,200 <sup>p</sup>
Uzbekistan <sup>c</sup>	4,300	4,300	4,300	4,300	4,300
Venezuela	147,000	149,000	176,000	202,000 <sup>r</sup>	200,000
Zimbabwe	728	816	1	--	--
Total	14,100,000 <sup>r</sup>	14,300,000 <sup>r</sup>	14,800,000 <sup>r</sup>	15,100,000 <sup>r</sup>	15,400,000

See footnotes at end of table.

TABLE 8—Continued  
FELDSPAR: WORLD PRODUCTION, BY COUNTRY<sup>1,2</sup>

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<sup>c</sup>Estimated. <sup>p</sup>Preliminary. <sup>r</sup>Revised. -- Zero.

<sup>1</sup>World 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>Table includes data available through April 24, 2007.

<sup>3</sup>In addition to the countries listed, China, Namibia, the United Arab Emirates, and Yemen may produce feldspar, but output is not officially reported available general information is inadequate for the formulation of reliable estimates of output levels.

<sup>4</sup>Data are for fiscal years beginning April 1 of year stated.

<sup>5</sup>Reported figure.

<sup>6</sup>Data are for fiscal years ending July 7 of year stated.

<sup>7</sup>Of the amounts shown, the dedicated feldspar mine production accounts for only part of total feldspar production.

<sup>8</sup>In June 2006, Montenegro and Serbia formally declared independence from each other and dissolved their union. Mineral production data for 2006, however, still reflect the unified country.