Feldspar, Nepheline Syenite, and Aplite

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The quantity of feldspar produced in 1977 (table 1) was slightly lower than in 1976, and some sharp ups and downs took place during the year. With the severe winter of 1977, transportation, mining activities, and gas supplies for customers were severely curtailed. Because of these problems there was a temporary shortage of feldspar later in the year when customers began to catch up. Costs of electric power, fuel for drying, and equipment were advancing at the rate of 10% per year or more. Transportation costs of feldspathic products were also steadily advancing.

In the latter part of 1977, Indusmin, Ltd., of Canada purchased all shares of Lawson-United Feldspar and Mineral Co. in Spruce Pine, N.C. Indusmin produces nepheline syenite at Nephton, Ontario.[2]

Legislation and Government Programs.— According to provisions of the Tax Reform Act of 1969, which continued in force throughout 1977, the depletion rate allowed on feldspar production (both domestic and foreign operations) was 14%.

Table 1.—Salient feldspar statistics

		1973	1974	1975	1976	1977
United States:						
Feldspar produced[1]	short tons	791,900	762,723	669,898	739,684	733,963
Value	thousands	$12,830	$11,396	$11,728	[2]$17,531	[2]$17,186
Exports	short tons	9,554	18,319	9,543	6,144	6,202
Value	thousands	$466	$662	$507	$352	$394
Imports for consumption	short tons	367	92	290	93	242
Value	thousands	$26	$4	$23	$18	$8
Consumption, apparent[3]	short tons	782,713	744,496	660,645	733,633	728,003
World production	thousand short tons	3,050	3,319	r2,895	r2,936	3,045

rRevised.
[1]Includes hand-cobbed feldspar, flotation-concentrate feldspar, and feldspar in feldspar-silica mixtures.
[2]Data represent a more refined product and are not comparable to previous years.
[3]Measured by quantity produced plus imports, minus exports.

FELDSPAR

DOMESTIC PRODUCTION

The quantity of feldspar in 1977 ready to be put into final form for use (that is, the total quantity of hand-cobbed feldspar, flotation concentrate feldspar, and feldspar content of feldspar-silica mixtures) was down slightly in tonnage and value compared with that of 1976. The values in table 2 for 1976 and 1977 represent a more refined product.

Feldspar was mined in 10 States with North Carolina in the lead, followed in descending order by Connecticut, Georgia, California, Oklahoma, South Dakota, Arizona, Wyoming, Colorado, and Maine. The combined output of the first four States named amounted to 93% of the U.S. total.

Most of the feldspar used in glassmaking is ground no finer than 20 mesh, and

substantial tonnages of feldspathic sands (feldspar-quartz mixtures) enter into glass furnace feeds with no further reduction in particle size. Feldspar to be used in ceramic and filler applications is usually pulverized to minus 200 mesh or finer. In 1977, 14 U.S. companies operating 16 plants produced feldspar in 10 States for shipment to destinations in at least 24 States, Puerto Rico, Canada, and Mexico. North Carolina had five plants, California had two, and the other producing States had one plant each: Arizona, Colorado, Connecticut, Georgia, Maine, Oklahoma, South Dakota, and Wyoming. In October of 1977, Indusmin, Ltd., of Canada purchased all shares of Lawson-United Feldspar and Mineral Co., Spruce Pine, N.C., through its subsidiary, American Nepheline Corp., Columbus, Ohio.[3] Indusmin produces nepheline syenite at Nephton, Ontario. In Maine, operation of the feldspar mill at West Paris was to resume in the spring of 1978 under the new owner, Oxford Feldspar and Mineral Corp.

Table 2.—Feldspar produced in the United States

(Thousand short tons and thousand dollars)

Year	Hand-cobbed		Flotation concentrate		Feldspar-silica mixtures[1]		Total[2]	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1973	53	636	546	9,789	193	2,406	792	12,830
1974	46	412	580	8,784	137	2,199	763	11,396
1975	17	274	531	9,260	122	2,193	670	11,728
1976[3]	28	321	601	13,606	111	3,603	740	17,531
1977[3]	23	309	568	12,602	142	4,276	734	17,186

[1]Feldspar content.
[2]Data may not add to totals shown because of independent rounding.
[3]Value data represent a more refined product and are not comparable to those of previous years.

Table 3.—Feldspar sold or used by producers, by use

Use	1976		1977	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Hand-cobbed:				
Glass	100	$4	--	--
Pottery	W	W	W	W
Other	26,903	925	24,600	$988
Total	27,003	929	24,600	988
Flotation concentrate:				
Glass	401,899	8,474	309,233	6,652
Pottery	180,200	4,827	W	W
Other	731	13	259,644	7,982
Total	582,830	13,314	568,877	14,634
Feldspar-silica mixture:[1]				
Glass	89,679	2,911	104,851	3,208
Pottery	W	W	W	W
Other	31,301	1,232	36,293	1,665
Total	120,980	4,143	141,144	4,873
Total:				
Glass	491,678	11,389	414,084	9,860
Pottery	221,740	6,102	253,375	7,755
Other[2]	17,395	895	67,162	2,880
Total	730,813	18,386	734,621	20,495

W Withheld to avoid disclosing individual company confidential data; included with "Other."
[1]Feldspar content.
[2]Includes soaps, abrasives, sanitary ware, rubber, electrical insulators, etc.; totals for "Quantity" and "Value" do not correspond to the sums of the subtotals of the three "Other" categories above.

Table 4.—Feldspar sold or used by producers in the United States in 1977, by State

(Short tons)

Destination	Quantity
Arkansas	5,488
California	40,151
Colorado	W
Illinois	36,971
Indiana	30,820
Kentucky	10,145
Louisiana	16,189
Maryland	5,041
Massachusetts	18,369
Michigan	848
Minnesota	W
Mississippi	20,780
Missouri	7,618
New Jersey	45,064
New York	20,637
Ohio	63,292
Oklahoma	34,339
Pennsylvania	53,737
Rhode Island	W
Tennessee	21,677
Texas	39,423
Washington	W
West Virginia	36,978
Wisconsin	W
Other destinations[1]	227,054
Total	734,621

W Withheld to avoid disclosing individual company confidential data; included with "Other destinations."
[1]Includes other States, States indicated by symbol W, and exports to foreign destinations.

CONSUMPTION AND USES

In 1977, there was as usual no significant consumption of feldspar in the raw, unprocessed state in which it is taken from the mine. The majority of users acquired their supplies already ground and sized by the feldspar producers, although some manufacturers of pottery, soaps, and enamels continued to purchase feldspar for grinding to their preferred specifications in their own mills. It should be noted that a substantial portion of the material classified as feldspar-silica mixtures serves in glassmaking without additional processing.

The 1977 end use distribution of feldspar in the United States indicated that 56% of the total was consumed in glassmaking and 34% was used in pottery. The remaining 10% was used in a diversity of applications, including glazes, enamels, soaps, abrasives, sanitary ware, rubber products, and electrical insulators.

PRICES

Engineering and Mining Journal, December 1977, listed the following prices for feldspar, per short ton, f.o.b. mine or mill, carload lots, bulk, depending on grade (prices were generally about $2.50 per ton higher than the corresponding quotations of the preceding year):

North Carolina:	
20 mesh, flotation	$20.25
40 mesh, flotation	$29.00- 30.50
200 mesh, flotation	30.75- 44.00
Georgia:	
40 mesh, granular	29.00- 30.50
200 mesh	39.50- 43.30
Connecticut:	
20 mesh, granular	24.50
200 mesh	32.00

Feldspar prices were quoted by Industrial Minerals (London), December 1977, as follows (converted from pounds sterling per metric ton to dollars per short ton):

Ceramic grade, powder, 200 mesh, bagged, ex-store	$77-$86
Sand, 2-3 millimeters, ceramic and/or glass grade, c.i.f. main European port	43- 55

FOREIGN TRADE

In 1977, U.S. exports classified as feldspar, leucite, and nepheline syenite (but presumably all or mostly feldspar) amounted to 6,202 tons valued at $393,845. This was about the same tonnage reported in 1976 and a 12% increase in value. Chief recipients of the exported material were Canada, 70%; Mexico, 9%; and Ecuador, 6%. The remaining 15% was shared among 11 other countries.

U.S. imports for consumption of feldspar in 1977, although higher than in 1976, still amounted to only a small fraction of the quantity exported (4% of the tonnage, 2% of the total value). In addition to feldspar and nepheline syenite, U.S. imports in 1977 included 1,431 tons of material, probably feldspathic in nature, that was classified as "Other mineral fluxes, crushed" with a total value of $197,255.

The tariff schedule in force throughout 1977 provided for a 3-1/2% ad valorem duty on ground feldspar; imports of unground feldspar were admitted duty-free.

Table 5.—U.S. imports for consumption of feldspar

Country	1976		1977	
	Quantity (short tons)	Value	Quantity (short tons)	Value
Crude: Canada	93	$17,614	--	--
Ground, crushed, or pulverized: Sweden	--	--	242	$8,115

WORLD REVIEW

Japan.—A comprehensive journal article featured the industrial mineral industries of Japan.[4] Feldspar was briefly discussed; annual production has been about 50,000 tons per year during the past few years, largely from the Taishu mine in Nagasaki Prefecture operated by Kyoritsu Ceramic Materials Co., Ltd. Another producer is Kamamare Feldspar Co. To supplement the domestic production, some 5,000 tons per year of feldspar is imported from the Republic of Korea, the People's Republic of China, and India.[5]

Norway.—Very good results were achieved in the purification of a feldspar-quartz flotation feed during a 4-month test program at KS Norfloat's Lillesand plant. A high-gradient magnetic separator was used. Although the feed contained fairly large amounts of tramp iron, there was no clogging requiring plant shutdown.[6]

Pakistan.—Large reserves of nepheline syenite were said to have been reported in North-West Frontier Province. Although domestic demand is limited, the provincial government was expected to make detailed investigations of the deposit to assess its potential in terms of export markets.[7]

Portugal.—Large outcrops of granitic and pegmatitic rock have been exploited commercially for quartz and feldspar in the past dozen years. The potash feldspar varies between 11.3% and 12.5% K_2O. The Unimil-Minerals/Quartzograno organization holds some 10 concessions for feldspar, all within 93 miles of Oporto. Two quartz-feldspar mines were in operation. The company predicted that production for 1977 would be 6,600 to 11,000 tons of potash feldspar and 1,100 to 2,200 tons of soda feldspar.[8]

Thailand.—Thailand's feldspar mining industry began in February 1972, with the startup of an operation in Rat Buri Province with a production of 1,400 tons.[9] Subsequently, production was begun in three or four other provinces. In 1975, production for the entire country was approximately 14,300 tons. The main producers were Thep Prathan Co. and Cermas Co. Both soda and potash feldspars were produced.

United Kingdom.—Imports of feldspar (ground and unground) in 1976 amounted to 146,308 tons. Principal countries of origin and the share supplied were Norway, 57%; Finland, 27%; and Sweden, 13%. Nepheline syenite imports were 43,000 tons in 1976 and came from Norway, 81%, and Canada, 19%.[10]

Table 6.—Feldspar: World production, by country

(Short tons)

Country[1]	1975	1976	1977[p]
North America:			
Guatemala	[e]33,000	[r e]22,000	14,408
Mexico	158,521	80,732	[e]83,000
United States	669,898	739,684	733,963
South America:			
Argentina	[r]63,934	75,204	85,274
Brazil[2]	[r]73,167	92,742	[e]94,000
Chile	421	106	[e]110
Colombia	36,376	[e]36,500	36,500
Peru	[e]3,300	4,305	[e]4,500
Uruguay	1,939	1,262	1,700
Europe:			
Finland	75,593	75,192	[e]77,000
France	[r]219,360	207,234	[e]215,000
Germany, Federal Republic of	436,331	462,944	[e]475,000
Italy	[r]206,522	201,287	[e]244,000
Norway[3]	49,557	41,546	44,000
Poland[e]	33,000	33,000	33,000
Portugal	14,506	14,686	11,908
Romania[e]	64,000	64,000	66,000
Spain[4]	95,102	[r e]100,000	[e]100,000
Sweden	49,320	49,324	[e]50,000
U.S.S.R.[e]	310,000	310,000	320,000
United Kingdom (china stone)[e]	55,000	55,000	55,000
Yugoslavia	60,129	27,983	[e]27,600
Africa:			
Egypt	[r]937	2,346	[e]2,400
Kenya	1,781	[e]1,800	2,060
Madagascar	753	--	--
Mozambique[e]	950	950	1,000
Nigeria[e]	5,500	5,500	5,500
South Africa, Republic of	33,460	50,858	56,172
Zambia	1,294	570	[e]900
Asia:			
Burma	840	981	1,356
Hong Kong	2,270	2,534	[e]2,800
India	[r]46,817	58,878	[e]58,741
Japan[5]	43,494	45,434	[e]47,000
Korea, Republic of	22,198	28,889	54,425
Pakistan	2,981	3,299	[e]3,300
Philippines	4,307	16,799	15,988
Sri Lanka	859	3,526	3,600
Thailand	14,358	13,511	[e]14,000
Oceania: Australia	3,366	4,958	[e]3,300
Total	[r]2,895,141	2,935,564	3,044,505

[e]Estimate. [p]Preliminary. [r]Revised.

[1]In addition to the countries listed, the People's Republic of China, Czechoslovakia, and the Territory of South-West Africa (Namibia) produce feldspar, but output is not officially reported and available general information is inadequate to formulate reliable estimates of output levels.

[2]Series revised to represent sum of (1) run-of-mine production for direct sale and (2) salable beneficiated product; total run-of-mine production was as follows in short tons: 1975, 84,248; 1976, 93,822; 1977, (estimated) 95,000.

[3]Described in source as lump feldspar; does not include nepheline syenite as follows in short tons: 1975, 203,326; 1976, [e]200,000; 1977, not available.

[4]Includes pegmatite.

[5]In addition, the following quantities of aplite were produced in short tons: 1975, 357,056; 1976, 394,533; 1977, not available.

TECHNOLOGY

Extracting alumina from anorthosite (essentially a monomineralic soda-lime feldspar rock) was one of the processes slated for testing by the Federal Bureau of Mines in its program on extracting alumina from nonbauxitic sources. Some laboratory work on the anorthosite testing was being performed; however, for the time being, emphasis is being placed on recovering alumina from clays, using nitric and hydrochloric acid processes.

A patent was granted for the purification of feldspar (and other minerals) containing titanium oxide or iron oxide gangue mine-

rals. This is done by passing the particulate mineral through an elongated chamber having a plurality of parallel ferromagnetic filaments.[11]

The importance of air with constant temperature and humidity in glass melting was discussed. Large amounts of air (fan, blower, and compressed) are used around a glass plant for cooling and combustion for tanks, mold cooling, tempering of flat glass, etc. Air temperature and its humidity vary greatly between night and day, from day to day, and over the different seasons of the year.[12]

Glass fibers might replace the copper in cable for telephone and other telecommunication uses. In this new field of glass circuitry, telephone conversations, television broadcasts, etc., are sent through glass fibers instead of conventional copper wires. A typical copper telephone cable used under big city streets is 3 inches thick and weighs 9 pounds per foot. A comparable glass cable would be one-half inch thick and would weigh one-tenth pound per foot. A major difficulty is manufacturing glass of a very high purity. Several firms in North America, Japan, and Europe, and two independent scientists in the United States were working to produce highly pure glass fiber at the lowest possible cost.[13]

Fiber glass, a popular reinforcement for automobiles and boats, is finding new applications in construction materials such as gypsum products and cement. Products such as decorative gypsum ceiling wall panel systems were entering the marketplace. Development was being carried out on fiber glass reinforced concrete slab-on-grade foundation construction.[14]

Glass-fiber reinforced plastics are finding use in pressure vessels, especially in the chemical processing industry. Pressure vessels have long been a bastion of an all-metal technology. Switching to plastic rests on the right combination of structural strength with chemical resistance, weight, and cost savings.[15]

As part of an energy conservation program at its sulfur mine, a U.S. company was converting from use of a thin, low-density, blanket-type pipe insulation to a thick, high-density, molded fiber glass insulation. As a result, this new reusable fiber glass insulation saved both energy and maintenance costs.[16]

Information on production and producers, trade, consumption, etc., of the raw materials used in the glass industry became available.[17] Another work dealt with the use of waste glass in the production of foam glass insulation, both in the bulk or rigid board form and pellet form.[18]

NEPHELINE SYENITE

Nepheline syenite is a light-colored rock that, although resembling medium-grained granite in texture, contains a significantly smaller proportion of quartz and consists principally of nepheline and alkali feldspars, usually in association with minor amounts of other minerals. Large quantities of nepheline syenite (after processing to remove objectionable substances, especially iron-bearing minerals) are consumed in making glass and ceramics. There is no domestic production of nepheline syenite in grades suitable for these purposes, however, and U.S. needs are wholly supplied by imports.

In Canada, two firms mine nepheline syenite from the deposit at Blue Mountain, Ontario: Indusmin, Ltd., and International Minerals & Chemical Corp. (Canada) Ltd. Canadian production in 1976, the last year for which an estimate is available, totaled approximately 596,000 tons valued at $10.8 million. This represented a 15% increase in tonnage and a 22% increase in value compared with that of 1975. The quantity exported to the United States in 1977 was 502,556 tons.

Other than Canada, only two countries are known to produce significant quantities of nepheline syenite—Norway with 345,000 tons in 1976, and the U.S.S.R. where, although production figures are not released, the mineral is known to serve the customary applications of the glass and ceramics industries and also as a major source of cell-feed alumina for electrolytic aluminum plants.

The price range quoted for imported nepheline syenite in Ceramic Industry magazine, January 1978, was from $13.60 to $36.75 per ton, depending upon grade, purity, grind, packaging, transportation, quantity sold, and other factors. Industrial Minerals (London), December 1977, quoted price ranges for Norwegian nepheline syenite, c.i.f. main European port, as follows (con-

verted from pounds sterling per metric ton to dollars per short ton):

Glass grade, 32 mesh (Tyler), bulk, per short ton	$46-$48
Ceramic grade, 325 mesh (Tyler), bagged, per short ton	71

Prices for Canadian material were listed as "nominal."

The June 5, 1978, issue of American Paint & Coatings Journal quoted paint-grade nepheline syenite in 50-pound bags, carload lots, f.o.b. Ontario, at $38.50 to $56.00 per ton.

Table 7.—U.S. imports for consumption of nepheline syenite

Year	Crude		Ground	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1975	6,275	$98	424,838	$6,869
1976	2,112	38	499,135	8,785
1977	860	17	501,696	9,118

APLITE

Aplite is another natural material of granitic texture containing quartz mixed with varying proportions of soda or lime-soda feldspar; it is usually not suitable for use in ceramics but, if sufficiently low in iron, finds ready acceptance in the manufacture of glass, especially container glass. Japan, with an annual production of 400,000 to 500,000 tons, is the world's foremost producer of aplite.

Aplite of glassmaking quality was produced in the United States in 1977 only from two open pit operations in central Virginia. The Feldspar Corp. mined aplite near Montpelier, Hanover County, and treated the material by wet-grinding, classification, and gravity separation, followed by dewatering, drying, and high-intensity magnetic separation to eliminate iron-bearing minerals. IMC Chemical Group, Inc., operated an aplite mine near Piney River, Nelson County, and removed ferruginous material from the dry-ground ore by a high-intensity magnetic process.

Domestic output tonnage was about the same in 1977 as in 1976. The amount of aplite sold during the year was estimated at 190,000 to 200,000 tons. The price for low-iron material was $16.00 per ton, f.o.b. plant.[19]

[1]Physical scientist, Division of Nonmetallic Minerals.
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[19]Work cited in footnote 2.