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2012 Minerals Yearbook

FLUORSPAR

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Fluorspar

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In 2012, there were no fluorspar mines operating in the United States. A small amount of fluorspar may have been recovered as a byproduct of limestone quarrying in Illinois and then screened and sold as metallurgical grade. Work continued in Livingston County, KY, on development of the Klondike II Mine. The bulk of U.S. consumption was supplied by imports and small amounts of byproduct synthetic fluorspar produced from industrial waste streams. Byproduct fluorosilicic acid (FSA) production from some phosphoric acid producers supplemented fluorspar as a domestic source of fluorine but was not included in fluorspar production or consumption calculations. Estimated world production increased by 5% compared with that of 2011, with most of the increase accounted for by increased production in China and Mongolia (table 9).

Fluorspar is used directly or indirectly to manufacture such products as aluminum, gasoline, insulating foams, plastics, refrigerants, steel, and uranium fuel. Most fluorspar consumption and trade involve either acid grade (also called acidspar), which is greater than 97% calcium fluoride (CaF_2), or subacid grade, which is 97% or less CaF_2. Subacid grade includes metallurgical and ceramic grades and is commonly called metallurgical grade or metspar.

Efforts continued to develop and introduce new fluorine-containing products (hydrofluoroolefins, for example) to replace fluorocarbon compounds with high global warming potentials (GWP). The GWP of a gas describes its total warming impact relative to carbon dioxide (CO_2) during a set period. This means, for example, that a gas with GWP of 100 would trap 100 times the heat trapped by an equivalent amount of CO_2. Many of the currently used fluorocarbon compounds, such as hydrofluorocarbon 134a (HFC 134a), have high GWPs and efforts are underway to phase out their production and use. Production of the various fluorocarbons account for a very significant portion of global fluorspar consumption.

Production

In 2012, small amounts of byproduct fluorspar may have been produced in Illinois by a single company, but no attempt was made to collect data on quantities produced. The U.S. Geological Survey (USGS) has no data survey for synthetic fluorspar produced in the United States. FSA was produced as a byproduct from the processing of phosphate rock into phosphoric acid. Domestic production data for FSA were developed by the USGS from a voluntary canvass of U.S. phosphoric acid operations known to recover FSA. Of the five FSA operations surveyed, responses were received from all, representing 100% of the total sold or used by producers.

In 2012, three companies produced marketable byproduct FSA at phosphoric acid plants (part of phosphate fertilizer operations). J.R. Simplot Co., Mosaic Fertilizer LLC (a subsidiary of The Mosaic Co.), and PCS Phosphate Co. Inc. operated five plants in Florida, Louisiana, North Carolina, and Wyoming that produced marketable FSA. Production of byproduct FSA was, at 100% basis, 73,600 metric tons (t), an increase of about 5% compared with that of 2011. Quantities sold or used were the same (equivalent to about 130,000 t of fluorspar grading 92% CaF_2).

Some synthetic fluorspar was recovered as a byproduct of petroleum alkylation, stainless steel pickling, and uranium processing. The majority of the marketable product was estimated to come from uranium processing, but the actual amount of synthetic fluorspar recovered is unknown.

Hastie Mining and Trucking Co. (Cave-In-Rock, IL), Core Metals Group (Aurora, IN), and Seaforth Mineral & Ore Co. Inc. (East Liverpool, OH) marketed screened and dried imported acid- and metallurgical-grade fluorspar. Hastie Mining also screened and sold small amounts of byproduct fluorspar from the company's limestone quarry operation.

Hastie Mining continued the development of its Klondike II underground fluorspar mine in Livingston County, KY. In addition to continuing to drive the inclined shaft toward the orebody, necessary work was performed on the shaft to improve access and safety. Work was delayed as a result of excessive rains late in the year. In addition, exploration work began in adjoining Crittenden County, KY, by parties unrelated to the Klondike II Mine project. The drilling program reportedly targeted the Tabb Fault System in southern Crittenden County (Boyce Moodie, Moodie Minerals Co., oral commun., May 22, 2013). No results of the drilling program have been made public.

The Kentucky Geological Survey (KGS) published a new map of the Western Kentucky Fluorspar District (Map and Chart 201, Series XII, 2012) (Kentucky Geological Survey, 2013). The map shows all the known mines, mineral prospects, and igneous intrusions (dikes or sills) of the Western Kentucky Fluorspar District, which includes Caldwell, Crittenden, and Livingston Counties. The map, released in late December as a geospatial PDF file, is available for free download at the KGS Web site (Anderson and Sparks, 2012). With renewed interest in locating and developing new domestic sources of fluorspar, exploration companies could find this map useful.

Consumption

Domestic consumption data were developed by the USGS from a quarterly survey of two large consumers that provide data on hydrofluoric acid (HF) consumption and four distributors that provide data on the merchant market (metallurgical and other uses). Responses were received by four of the six companies and estimates were made for the two nonrespondents based on prior years' data and industry sources where available. These

combined data comprise 100% of the reported consumption in table 2.

Industry practice has established three grades of fluorspar—acid grade, containing more than 97% CaF_2; ceramic grade, containing 85% to 95% CaF_2; and metallurgical grade, normally containing 60% to 85% CaF_2. Fluorspar grades are defined by the intended use, but these grades are essentially ranges derived from customer and supplier specifications. For reasons ranging from availability to economics to process changes, U.S. consumers have been moving toward the use of higher-grade fluorspar. For example, welding rod manufacturers may use acid-grade fluorspar rather than ceramic grade, and some steel mills use ceramic or acid grade rather than metallurgical grade.

Total reported U.S. fluorspar consumption was 416,000 t, about 9% less than the revised figure for 2011 (table 2). Consumption data for the two HF producers has been combined with "Other" uses in table 2 to avoid disclosing company proprietary data. Apparent consumption (normally defined as production plus imports minus exports plus or minus changes in stocks) decreased by 22% to 525,000 t. A substantial portion of the decrease was the result of a large increase in domestic stocks. However, some uncertainty exists about the accuracy of the large increase in U.S. fluorspar imports during the past 2 years, as no direct reason for the large increase was evident and the reported exports of fluorspar to the United States from its major trading partners were much lower than reported U.S. imports. It is possible that Mexican fluorspar is moving through ports in the United States for reexport but not being properly reported in the U.S. trade statistics.

Acid-grade fluorspar, which accounted for 91% of the total U.S. reported fluorspar consumption, was used primarily as a feedstock in the manufacture of HF. Two companies reported fluorspar consumption for the production of HF in 2012—E.I. du Pont de Nemours and Co. Inc. (DuPont) and Honeywell International Inc. Fluorspar consumption for HF production decreased compared with that of 2011 because of the fourth quarter shutdown of DuPont's HF plant for maintenance. Because most acid-grade fluorspar is converted to HF before consumption, HF uses and markets are key to analyzing fluorspar consumption.

The leading use of HF was for the production of a wide range of fluorocarbon chemicals, including hydrofluorocarbons (HFCs) and hydrochlorofluorocarbons (HCFCs), fluoroelastomers, and fluoropolymers. Production of these compounds accounted for about 75% of domestic HF consumption and 40% of world HF consumption. Major U.S. producers were Arkema Inc., DuPont, Honeywell, Mexichem Fluor, Inc., MDA Manufacturing Ltd., and Solvay Solexis Inc.

Internationally, acid-grade fluorspar was used in the production of aluminum fluoride (AlF_3) and cryolite (Na_3AlF_6), which are the main fluorine compounds used in primary aluminum smelting. Alumina (Al_2O_3) is dissolved in a bath that consists primarily of molten cryolite and small amounts of AlF_3 and fluorspar to allow electrolytic recovery of aluminum. During the aluminum smelting process, excess sodium in the bath (a result of impurities in the alumina) is controlled by the addition of AlF_3, which reacts with the sodium to form cryolite. This reaction results in excess bath material, which is drawn off in a liquid form, allowed to cool and solidify, and can then be crushed and reused to start up new pots or to compensate for electrolyte losses. This excess material is variously called crushed tapped bath, secondary cryolite, bath cryolite, as well as other terms. In the aluminum smelting process, AlF_3 is used also to replace fluorine losses (either absorbed by the bath walls or captured as emissions). Most AlF_3 is produced directly from acid-grade fluorspar or from byproduct FSA. The United States ceased production of AlF_3 in 2008 when Alcoa World Alumina LLC (a business unit of Alcoa Inc.) closed its Point Comfort, TX, production facility. The AlF_3 requirements of U.S. aluminum industry were met through imports in 2012 (table 8).

The merchant fluorspar market in the United States included sales of metallurgical- and acid-grade material mainly to steel mills, where it was used primarily as a fluxing agent to increase the fluidity of the slag. Sales were also made to smaller markets such as cement plants, foundries, glass and ceramics plants, and welding rod manufacturers in railcar, truckload, and less-than-truckload quantities. Complete data on merchant fluorspar sales cannot be shown because consumption of acid-grade fluorspar for HF production has been combined with other uses in table 2 to prevent disclosure of company proprietary data. In 2012, based on available data, merchant sales (excluding acid-grade for other uses) increased by about 9% compared with those of 2011. During the past 20 to 30 years, fluorspar usage in such industries as steel and glass has declined because of product substitutions or changes in industry practices.

The U.S. steel industry's recovery from the effects of the 2008–09 recession slowed in 2012 with raw steel production increasing by less than 3% to 88.6 million metric tons (Mt) (World Steel Association, undated). In the United States, reported consumption of fluorspar in metallurgical markets (mainly steel) increased by nearly 9% compared with the revised figure for 2011. Consumption in this sector was 75% metallurgical grade and 25% acid grade.

In the United States, FSA is used primarily for water fluoridation, but it also is used as a metal surface treatment and cleaner and for pH adjustment in industrial textile processing or laundries. It can also be used in the processing of animal hides, for hardening masonry and ceramics, and in the manufacture of other chemicals. In 2012, byproduct FSA sales totaled 73,600 t, with the vast majority going for water fluoridation.

Stocks

Data for stocks were available from some fluorspar distributors and HF producers. Known consumer and distributor stocks at the end of 2012 totaled 234,000 t, an increase of 44% compared with those at yearend 2011. Explanations for the large increase in stocks include reduced consumption caused by lower demand and the longer than expected shutdown of the DuPont HF plant in Texas for maintenance in the fourth quarter. In addition, it was possible that some stockpiling was undertaken prior to the expiration of long-term supply contracts under the expectation that prices in the new contracts would be higher.

The U.S. Government began stockpiling fluorspar in 1943 and through various programs acquired fluorspar until 1963. When the last acquisition was made, the quantities held by the Government at various stockpile locations totaled about 1.04 Mt

of acid-grade fluorspar and 374,000 t of metallurgical-grade fluorspar. The need for a Government stockpile was considered justified for National defense purposes until the early 1990s when the political climate changed (collapse of the Soviet Union) and the major rationale for maintaining the stockpile disappeared. Based on revised national security needs dictated by new post-cold war planning assumptions, the U.S. Department of Defense was authorized to dispose of the entire fluorspar stockpile (U.S. Department of Defense, 1993). Between 1992 and 2006, the entire fluorspar stockpile was sold. U.S. Government stocks of fluorspar are currently zero.

Transportation

The United States depends on imports for most of its fluorspar supply. Metallurgical-grade fluorspar is shipped routinely as lump or gravel, with the gravel passing a 75-millimeter (mm) sieve and not more than 10% by weight passing a 9.5-mm sieve. Acid-grade fluorspar is shipped in the form of damp filtercake that contains 7% to 10% moisture to facilitate handling and to reduce dust. This moisture is removed by heating the filtercake in rotary kilns or other dryers before treating with sulfuric acid to produce HF. Acid-grade imports from China and South Africa are usually shipped by ocean freight using bulk carriers of 10,000- to 50,000-t deadweight capacity; ships in this size range are termed "handymax." Participants negotiate freight levels, terms, and conditions. Some acid grade and ceramic grade are marketed in bags for small users and shipped by truck.

International ocean shipping rates for dry bulk carriers fell substantially in 2012 compared with rates in 2011. Low demand for shipping coupled with increased shipping capacity in the form of new ships contributed to lower prices. The low shipping rates benefited fluorspar buyers in the United States importing fluorspar from overseas suppliers such as China and South Africa.

Prices

According to Industrial Minerals magazine, yearend 2012 prices for Chinese acidspar decreased by about 10% compared with yearend 2011. Mexican acidspar (low and high arsenic) prices remained unchanged, while the South African acidspar price increased by 25% (table 3).

Foreign Trade

In 2012, U.S. exports of fluorspar totaled 23,800 t and were essentially unchanged compared with those of 2011 (table 4). With the absence of fluorspar stocks in the National Defense Stockpile and only a small amount of mined fluorspar, exports are likely reexports of imported material. The leading recipients of U.S. exports were Canada (64%) and Taiwan (23%).

In 2012, imports for consumption of fluorspar decreased by 15% compared with those of 2011 (table 5). The leading suppliers of fluorspar to the United States were Mexico (74%), China (13%), and South Africa (9%).

The following imports are compared with those of 2011: imports of HF were essentially unchanged at 133,000 t (table 6); the majority of HF imports were from Mexico (86%), with Canada (8%) and China (4%) supplying most of the balance. Imports of cryolite decreased by 15% to 8,140 t (table 7). Imports of AlF_3 increased by 21% to 50,000 t (table 8), with almost all coming from three countries—Mexico (44%), Canada (34%), and China (22%).

World Review

The global fluorspar industry experienced a busy year, which saw acquisitions, capacity expansions, continued exploration activities, mine closures, mine restarts, and start up or release of technical studies. World fluorspar production increased, although a substantial portion of the increase was in the form of an increase in estimated Chinese and Mongolian production (table 9).

Canada.—Canada Fluorspar Inc. announced that Newspar, its 50-50 joint venture with Arkema, was undertaking a review of the St. Lawrence fluorspar project to establish a more precise understanding of the anticipated costs and scope of the project. This comprehensive review was to consider a range of mining and milling options applicable at the St. Lawrence fluorspar operations. At yearend, the expected commencement date for the construction of the project had yet to be determined (Canada Fluorspar Inc., 2012).

China.—In September 2011, China appealed the World Trade Organization (WTO) ruling that its export restrictions on several industrial raw materials (including fluorspar) were inconsistent with WTO rules. In late January 2012, the WTO Appellate Body affirmed a WTO dispute settlement panel's July 2011 finding that found China's export restraints, including export duties, export licenses, export quotas, and minimum export prices on fluorspar, to be inconsistent with China's WTO obligations and rejected China's attempts to portray its export restraints as conservation or environmental protection measures or measures taken to manage critical shortages of supply (Office of the U.S. Trade Representative, 2012). China had until yearend 2012 to comply with the WTO ruling.

China's 2012 fluorspar exports were 428,000 t, a decrease of 40% compared with those of 2011. Of the total, metspar accounted for 165,000 t with the Republic of Korea, India, and Japan, in descending order, being leading reported trading partners. Acidspar exports totaled 262,000 t, with the European Union, the United States, Japan, India, and Canada, in descending order, being the leading trading partners. China imported 124,000 t of fluorspar in 2012, the majority of which (118,000 t) came from Mongolia. Most of the quantity imported was classified as metspar, but the quantity could have also included below-grade acidspar (United Nations, 2013).

Kenya.—Kenya Fluorspar Co. Ltd. completed a de-bottlenecking project at its fluorspar mill, which included commissioning of an additional ball mill. The new ball mill was expected to allow a 20% increase in feed input to the flotation mill and allow the use of idle systems and cells within the plant. The project was expected to improve plant efficiencies and allow for an increase in acid-grade fluorspar output (Kenya Fluorspar Co. Ltd., 2012).

Mongolia.—Berkh Uul JSC announced the receipt of a National Instrument (NI) 43–101 compliant resource report on its Delgerkhan fluorspar deposit in Mongolia. The results were based on a 1,700-meter drilling program designed to confirm historic drilling results in order to bring the resource into NI

43–101 compliant format. Applying a 10% cutoff grade, results showed an indicated resource of 6.62 Mt grading 33.7% CaF_2 and an inferred resource of 3.02 Mt grading 33% CaF_2. The deposit was reportedly partially open at depth and additional exploration potential existed. Berkh Uul mined fluorspar until 2008 when operations were shut down, but the company hoped to reopen the Delgerkan Mine (Berkh Uul JSC, 2012).

Mozambique.—Globe Metals and Mining Ltd. released results of the preliminary drilling program performed on its Mount Muambe fluorspar and rare-earths project. Mount Muambe is a carbonatite crater roughly 4 kilometers in diameter in Mozambique's Tete Province. Drilling resulted in an inferred mineral resource estimate of 1.6 Mt grading 19% CaF_2 at a cutoff grade of 10% CaF_2. The fluorspar mineralization is near the surface and contains valuable byproduct rare-earth mineralization. The company reported that only a small area of the crater had been drilled, and reconnaissance work showed numerous other fluorite prospects within the crater (Brant, 2012).

Norway.—Tertiary Minerals plc announced the completion of an independent scoping study on its Lassedalen fluorspar project in southern Norway. A scoping study is a preliminary broad study conducted to investigate the approximate economics and viability of various development options for the mining and treatment of a mineral deposit. The study's basis was an inferred resource of 4 Mt of fluorspar averaging 24.6% CaF_2, with a target production of 100,000 metric tons per year (t/yr) of acid-grade fluorspar. Mining would be by sublevel open stoping and mineral processing would be by flotation resulting in a mine life of 6.6 years. Financial analysis was based on a selling price of $491 per metric ton delivered to Rotterdam. The overall results of the study were, in the company's opinion, sufficient to support further progress including additional drilling to increase the resource base and thereby increase the mine life and enhance project economics (Tertiary Minerals plc, 2012).

Russia.—United Company RUSAL (RUSAL) acquired 50% of Russia's leading fluorspar producer, Yaroslavsk Mining Co., from JSC Russian Ore Mining Co. RUSAL, the world's leading aluminum producer, already owned the other 50% of Yaroslavsk; this acquisition enabled RUSAL to become less dependent on outside sources of raw materials for its aluminum production. This asset was expected to cover 60% of RUSAL's current fluorspar concentrate requirements, and future expansion provides the potential for full coverage of the RUSAL's requirements. Under the Russian reserve classification system, Yaroslavsk has licenses controlling 22 Mt of fluorspar reserves, which at current mining rates would allow a mine life of 20 years (United Company RUSAL, 2012).

South Africa.—Fluormin Plc announced the sale of its Buffalo Fluorspar project in South Africa for about $1.38 million. Buffalo had been on care-and-maintenance status since 2008 with no plans to reopen (Fluormin Plc, 2012a). Fluormin's Witkop Mine in North West Province traditionally processed very low ore grades (13% to 14% CaF_2) compared with other fluorspar mines, and since restarting production in March 2011 the mine's ore-grade feed had dipped below 9% CaF_2. Fluormin was faced with several other challenges, including water shortages, power outages, unplanned plant maintenance, and higher-than-expected stripping ratios. The company began an infill drill program to reduce the feed grade variability and to locate near-term higher grade ore. Fluormin also implemented plant modifications and improved mining methods that reduced production costs. Despite these activities, in October, after the prevailing fluorspar price fell below its production costs, the company placed the Witkop Mine on care-and-maintenance status (Fluormin Plc, 2012b; Sharecast.com, 2013).

Minerales y Productos Derivados, S.A. (Bilbao, Spain), the majority owner of the Vergenoeg fluorspar mine in South Africa, announced that expansions at Vergenoeg had increased its acidspar capacity to 300,000 t/yr. In addition, a new processing plant was constructed that increased Vergenoeg's production capacity of metspar powder and briquettes to 30,000 t/yr (Lismore, 2012).

United Kingdom.—The assets and facilities of the United Kingdom's sole fluorspar producer, Glebe Mines Ltd., were acquired out of receivership by British Fluorspar Ltd. in May 2012. British Fluorspar, originally registered in the United Kingdom as Minmet UK Ltd., is wholly owned by Italy's Fluorsid Group. Fluorsid Group is also the majority shareholder of Fluorsid S.p.A., which produces aluminum fluoride and synthetic cryolite at its plant in Sardinia, Italy, and aqueous HF through its wholly owned subsidiary, Industrie Chimiche Ing. Bonelli (ICIB), at its plant in northern Italy (Rossina Palmiera, Executive Assistant, British Fluorspar Ltd., written commun., September 20, 2013). British Fluorspar planned to restart operations in early 2013 and supply acid-grade fluorspar to the ICIB and Fluorsid plants in Italy and to customers in northern Europe and the United Kingdom (Roberts, 2012).

Vietnam.—In 2012, work on Masan Resources' Nui Phao polymetallic mining project neared completion. Various mine and mill structures were built and equipment installation was completed. Access to critical supplies of power and water were achieved with the pre-commissioning of power supply for the project and commencement of the water pipeline from the Cong River. Commencement of the transition from construction to operations started with the handover of the tailings dams and commissioning of the thickener circuits in the flotation mill, which was expected to be in operation early in the second quarter of 2013 (Masan Group Corp., 2013, p. 42). When in full production, the mine should produce substantial amounts of bismuth, fluorspar, and tungsten, with lesser amounts of copper and gold. Annual acid-grade fluorspar production was projected to average in excess of 200,000 t/yr.

Outlook

The outlook for fluorspar has some long-term concerns that include environmental pressures opposing the use of some fluorochemical products, safety concerns regarding the use of HF, availability of future fluorspar supplies, and a shift in fluorspar-consuming industries to Asia. Global demand slowed in 2012 and prices softened as a result, a pattern that became more pronounced in the first half of 2013. Prices were expected to decrease in 2013 compared with those in 2012.

Long-term demand for fluorspar may depend to a large degree on the development and acceptance of fluorine-based replacements for existing fluorocarbon compounds, which

are likely to be phased out owing to high GWP. Strong replacement candidates are the hydrofluoroolefins HFO–1234yf, HFO–1234ze, and HFO-1233zd. These compounds all have low GWP and rapidly break down in the atmosphere. For the fluorspar industry, they also have the advantage of containing greater amounts of fluorine (thus requiring more fluorspar to manufacture) compared with some of the compounds they would replace.

Major markets for fluorspar in developed countries have been stagnant or have decreased as first HF and more recently fluorocarbon production has moved to China, and aluminum smelting capacity has moved to countries or regions with access to abundant, low-cost energy. This shift is evident in the increasing HF and fluorocarbon production capacity in China and the reduced capacities in traditional production areas in Europe, Japan, and North America. China is already the world's leading fluorspar consumer, and its share of global consumption will likely continue to increase in the future.

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TABLE 1
SALIENT FLUORSPAR STATISTICS[1, 2]

		2008	2009	2010	2011	2012
United States:						
Exports:[3]						
Quantity	metric tons	18,800	14,100	17,900	24,100	23,800
Value[4]	thousands	$3,340	$2,230	$2,740	$3,780	$3,640
Imports for consumption:[3]						
Quantity	metric tons	572,000	475,000	539,000	727,000	620,000
Value[5]	thousands	$133,000	$105,000	$103,000	$154,000	$157,000
Consumption:						
Reported	metric tons	506,000	400,000	446,000	456,000 r	416,000
Apparent[6]	do.	529,000	473,000	492,000	672,000	525,000
Stocks, December 31:						
Consumer and distributor	do.	115,000	103,000	131,000	162,000	234,000
World, production	do.	6,920,000	6,310,000 r	7,000,000 r	6,740,000 r	7,070,000 e

eEstimated. rRevised. do. Ditto.
[1]Data are rounded to no more than three significant digits.
[2]Does not include byproduct or synthetic fluorspar production.
[3]Source: U.S. Census Bureau; data may be adjusted by the U.S. Geological Survey.
[4]Free alongside ship values at U.S. ports.
[5]Cost, insurance, and freight values at U.S. ports.
[6]Imports minus exports plus adjustments for changes in stocks.

TABLE 2
U.S. REPORTED CONSUMPTION OF FLUORSPAR, BY END USE[1]

(Metric tons)

	Containing more than 97% calcium fluoride		Containing not more than 97% calcium fluoride		Total	
End use or product	2011	2012	2011	2012	2011	2012
Hydrofluoric acid and aluminum fluoride	W	W	--	--	W	W
Metallurgical	12,000	12,000	32,000 r	35,800	44,000 r	47,800
Other[2]	412,000	368,000	--	--	412,000	368,000
Total	424,000	380,000	32,000 r	35,800	456,000 r	416,000
Stocks, consumer, December 31	145,000	219,000	17,500	15,100	162,000	234,000

rRevised. W Withheld to avoid disclosing company proprietary data; included in "Other." -- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]May include cement, enamel, glass and fiberglass, hydrofluoric acid, steel castings, and welding rod coatings.

TABLE 3
PRICES OF IMPORTED FLUORSPAR

(Dollars per metric ton)

Source and grade	2011	2012
Acidspar:		
Chinese, dry basis, cost, insurance, and freight (c.i.f.) Gulf port, filtercake	550–650	480–600
Mexican, free on board (f.o.b.) Tampico, filtercake	400–450	400–450
Mexican, f.o.b. Tampico, arsenic <5 parts per million	540–550	540–550
South African, f.o.b. Durban, filtercake	330–335	380–450
Metspar, Mexican, f.o.b. Tampico	230–270	230–270

Source: Industrial Minerals magazine (London).

TABLE 4
U.S. EXPORTS OF FLUORSPAR, BY COUNTRY[1]

	2011		2012	
Country	Quantity (metric tons)	Value[2]	Quantity (metric tons)	Value[2]
Australia	97	$14,100	88	$12,800
Bolivia	--	--	27	3,900
Brazil	92	13,300	--	--
Canada	12,700	2,070,000	15,200	2,440,000
China	--	--	18	14,900
Dominican Republic	114	25,600	240	42,600
France	103	37,500	71	8,000
Germany	--	--	271	30,300
Indonesia	--	--	5	3,520
Israel	--	--	11	3,290
Mexico	745	123,000	512	60,700
Taiwan	9,790	1,440,000	5,360	780,000
Trinidad and Tobago	430	55,500	1,990	239,000
Venezuela	--	--	16	4,700
Total	24,100	3,780,000	23,800	3,640,000

-- Zero.

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

[2]Free alongside ship values at U.S. ports.

Source: U.S. Census Bureau.

TABLE 5
U.S. IMPORTS FOR CONSUMPTION OF FLUORSPAR, BY COUNTRY AND CUSTOMS DISTRICT[1]

Country and customs district	2011 Quantity (metric tons)	2011 Value[2] (thousands)	2012 Quantity (metric tons)	2012 Value[2] (thousands)
Containing more than 97% calcium fluoride (CaF_2):				
Canada, Cleveland, OH	1	$8	--	--
China:				
Houston, TX	119,000	60,000	71,800	$38,800
New Orleans, LA	--	--	8,960	4,440
New York, NY	--	--	44	25
Total	119,000	60,000	80,800	43,300
Germany, Cleveland, OH	--	--	17	18
Mexico:				
Baltimore, MD	762	172	1,380	850
Houston, TX	--	--	3,370	1,470
Laredo, TX	136,000	24,000	46,600	22,200
New Orleans, LA	264,000	40,900	252,000	46,200
Total	401,000	65,100	303,000	70,700
Mongolia, Houston, TX	--	--	9,910	4,890
South Africa:				
Houston, TX	34,300	9,440	52,300	16,000
New Orleans, LA	5,100	1,690	5,320	1,940
Total	39,400	11,100	57,600	17,900
Spain, Houston, TX	--	--	12,000	4,440
United Kingdom:				
Houston, TX	6	24	87	65
Los Angeles, CA	414	49	194	101
Total	420	73	281	166
Grand total	560,000	136,000	464,000	141,000
Containing not more than 97% CaF_2:				
China, Cleveland, OH	--	--	271	39
Mexico:				
Buffalo, NY	43	10	--	--
Cleveland, OH	--	--	238	26
Laredo, TX	6,070	797	5,190	713
New Orleans, LA	160,000	16,500	149,000	14,500
San Diego, CA	200	48	--	--
Total	167,000	17,300	155,000	15,200
Mongolia, Mobile, AL	--	--	1,050	98
Namibia, Houston, TX	--	--	419	37
Grand total	167,000	17,300	156,000	15,400
Grand total, all grades	727,000	154,000	620,000	157,000

-- Zero.

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

[2]Cost, insurance, and freight values at U.S. ports.

Source: U.S. Census Bureau.

TABLE 6
U.S. IMPORTS FOR CONSUMPTION OF HYDROFLUORIC ACID, BY COUNTRY[1]

Country	2011 Quantity (metric tons)	2011 Value[2] (thousands)	2012 Quantity (metric tons)	2012 Value[2] (thousands)
Belgium	--	--	(3)	$11
Canada	15,300	$40,700	10,800	31,300
China	5,060	8,020	5,890	8,260
France	(3)	4	--	--
Germany	262	703	233	608
Hong Kong	278	363	37	52
India	83	123	60	97
Japan	1,150	2,660	1,310	3,150
Korea, Republic of	--	--	21	24
Liechtenstein	--	--	2	104
Mexico	110,000	161,000	114,000	188,000
Singapore	113	402	113	425
South Africa	3	8	12	30
Spain	132	450	150	464
Taiwan	83	151	47	140
United Kingdom	--	--	1	138
Total	132,000	215,000	133,000	233,000

-- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Cost, insurance, and freight values at U.S. ports.
[3]Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 7
U.S. IMPORTS FOR CONSUMPTION OF CRYOLITE, BY COUNTRY[1]

Country	2011 Quantity (metric tons)	2011 Value[2] (thousands)	2012 Quantity (metric tons)	2012 Value[2] (thousands)
Australia	2	$18	--	--
Canada	235	96	962	$425
China	1,310	1,130	1,350	1,030
Croatia	--	--	20	31
Germany	1,990	2,950	2,190	3,110
Hungary	346	509	322	489
Iceland	2,780	1,850	--	--
Italy	19	33	--	--
Japan	2,230	3,410	2,760	4,170
Mozambique	282	257	81	74
Spain	--	--	2	6
United Kingdom	375	704	455	803
Total	9,560	11,000	8,140	10,100

-- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Cost, insurance, and freight values at U.S. ports.

Source: U.S. Census Bureau.

TABLE 8
U.S. IMPORTS FOR CONSUMPTION OF ALUMINUM FLUORIDE, BY COUNTRY[1]

Country	2011 Quantity (metric tons)	2011 Value[2] (thousands)	2012 Quantity (metric tons)	2012 Value[2] (thousands)
Canada	14,200	$21,200	16,800	$16,900
China	8,800	13,200	10,800	17,800
Mexico	18,200	23,900	22,200	30,900
Other[3]	46	92	180	231
Total	41,200	58,400	50,000	65,900

[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Cost, insurance, and freight values at U.S. ports.
[3]Includes all countries with quantities less than 1,000 metric tons.

Source: U.S. Census Bureau.

TABLE 9
FLUORSPAR: WORLD PRODUCTION, BY COUNTRY[1, 2]

(Metric tons)

Country[3, 4]	2008	2009	2010	2011	2012[e]
Argentina	15,098	13,424	17,657	25,099 r	18,000
Brazil, marketable:					
Acid grade	45,032	28,803	6,295 r	6,195 r	6,200 p
Metallurgical grade	18,209	15,161	18,152 r	18,843 r	18,900 p
Total	63,241	43,964	24,447 r	25,038 r	25,100 p
Bulgaria	--	--	--	4,500 e	12,000
China:[e]					
Acid grade	1,900,000	1,600,000	2,100,000	2,000,000 r	2,100,000
Metallurgical grade[5]	2,300,000	2,200,000	2,500,000	2,200,000 r	2,300,000
Total	4,200,000	3,800,000	4,600,000	4,200,000 r	4,400,000
Egypt	470 r	500 r	470 r	500 r	500
Germany, acid grade	48,519	49,962	59,086	65,619 r	61,500
India:[6]					
Acid grade	6,814	8,786	8,400 r	8,500 r	8,600
Metallurgical grade	3,176	4,996	4,600 r	4,800 r	5,000
Total	9,990	13,782	13,000 r	13,300 r	13,600
Iran[7]	61,592	71,409	72,000	70,000 r, e	70,000
Kazakhstan[e]	66,300 [8]	65,000 r	65,000 r	65,000 r	65,000
Kenya, acid grade	98,248	15,667	44,500	117,420	110,000 [8]
Korea, North	NA r	NA r	NA r	NA r	NA
Kyrgyzstan[e]	1,350 r	1,600 r	500 r	550 r	500
Mexico:					
Acid grade	591,955	640,676	719,122	731,456	754,000
Metallurgical grade	465,694	405,264	348,264	475,451	450,000
Total	1,057,649	1,045,940	1,067,386	1,206,907	1,204,000 [9]
Mongolia:[10]					
Acid grade[11]	115,700	115,300	140,700	116,400	157,200 [8]
Other grades	219,100	344,200	259,000 r, e	232,000 r, e	314,000 [8]
Total	334,800	459,500	400,000 r, e	348,000 r, e	471,200 [8]
Morocco, acid grade	56,724	69,091	75,380	79,207 r	78,000
Namibia, acid grade[12]	108,800	73,580	95,092	80,000 e	80,000
Pakistan, metallurgical grade[e]	1,700	1,400	1,500	1,600	1,700
Romania, metallurgical grade[e]	15,000	15,000	15,000	-- r	--
Russia[e]	269,000	140,000 r	125,000 r	110,000 r	100,000
South Africa:[e, 13]					
Acid grade	281,000	186,000 r	148,000 r	184,000 r	205,000
Metallurgical grade	18,000	12,000 r	9,000 r	12,000 r	20,000
Total	299,000	198,000 r	157,000 r	196,000 r	225,000

See footnotes at end of table.

TABLE 9—Continued
FLUORSPAR: WORLD PRODUCTION, BY COUNTRY[1, 2]

Country[3, 4]	2008	2009	2010	2011	2012[e]
Spain:					
Acid grade	127,300	111,810	126,730 [r]	109,284 [r]	109,000
Ceramic grade	15,930	6,485	1,824	2,639	2,600
Metallurgical grade	5,506	4,238 [r]	3,787 [r]	5,410 [r]	5,400
Total	148,736 [r]	122,533 [r]	132,341 [r]	117,333 [r]	117,000
Tajikistan	-- [r]	-- [r]	-- [r]	-- [r]	--
Thailand[14]	26,118	86,365	2,222	5,093 [r]	12,000
United Kingdom	36,801	18,536	26,420	--	--
Vietnam[e]	4,000	4,000	4,000	4,000	4,000
Grand total[e]	6,920,000	6,310,000 [r]	7,000,000 [r]	6,740,000 [r]	7,070,000

[e]Estimated. [p]Preliminary. [r]Revised. NA Not available. -- Zero.

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

[2]Table includes data available through July 2, 2013.

[3]An effort has been made to subdivide production of all countries by grade (acid, ceramic, and metallurgical). Where this information is not available in official reports of the subject country, the data have been entered without qualifying notes.

[4]In addition to the countries listed, North Korea and some other nations may produce fluorspar, but output data are not reported; available general information is inadequate to formulate reliable estimates of output levels.

[5]Includes submetallurgical-grade fluorspar used primarily in cement that may account for 33% to 50% of the quantity.

[6]Year beginning April 1 of that stated.

[7]Year beginning March 21 of that stated.

[8]Reported figure.

[9]Reported figure rounded, quantities by grade are estimated.

[10]Data are reported by the Mineral Resource Authority of Mongolia.

[11]Flotation concentrate, including less than 97% CaF_2 material.

[12]Data were in wet tons, but have been converted to dry tons to agree with other data in the table.

[13]Data for 2008 to 2011 based on data from the South African Minerals Bureau; data show estimated proportions of acid-grade and metallurgical-grade fluorspar within the reported totals.

[14]Data for 2008 to 2011 are as reported by the Thailand Bureau of Economics and International Cooperation, Department of Primary Industries and Mines.