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2008 Minerals Yearbook

FLUORSPAR [ADVANCE RELEASE]

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FLUORSPAR

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In 2008, there was no primary fluorspar production in the United States, although a small amount of fluorspar was recovered as a byproduct of limestone quarrying in Illinois and was screened and sold as metallurgical grade. The bulk of U.S. consumption was supplied by imports and by 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. According to the U.S. Census Bureau, U.S. imports of fluorspar decreased by about 8%, imports of hydrofluoric acid (HF) decreased by about 13%, and exports of fluorspar increased by 39% compared with those in 2007 (tables 1, 4–6).

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.

Production

In 2008, small amounts of byproduct fluorspar were produced in Illinois. There is no U.S. Geological Survey (USGS) data survey for synthetic fluorspar. FSA is 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 four plants, representing 94% of the total sold or used by producers. Production and sales data for the one nonrespondent were estimated based on prior year company data.

In 2008, there were three companies producing marketable byproduct FSA at phosphoric acid plants (part of a phosphate fertilizer operation). J.R. Simplot Co., Mosaic Fertilizer (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 62,300 metric tons (t) (100% basis), and quantities sold or used totaled 62,900 t (equivalent to approximately 111,000 t of fluorspar grading 92% CaF2) valued at about $14.2 million.

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), Oxbow Carbon and Minerals LLC (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 and Moodie Mineral Co. completed an exploration program on the Klondike II fluorspar project in Livingston County, KY. The company drilled 25 holes identifying fluorspar reserves in excess of 1 million metric tons (Mt) with an average grade of 52% CaF2. Plans to restart an idle flotation mill at Salem, KY, were delayed because the plant was vandalized while it sat idle. It will require a significant outlay of time and money to bring the mill back into operating condition. It was originally anticipated that mine development could begin in 2008, but the project experienced further delays caused by bad weather and last minute State permitting requirements (Boyce Moody, III, Moody Minerals Co., oral commun., September 3, 2008; March 12, 2009).

Consumption

Domestic consumption data were developed by the USGS from a quarterly consumption survey of three large consumers that provide data on HF and aluminum fluoride (AlF_3) consumption and four distributors that provide data on the merchant market (metallurgical and other uses). Quarterly data were received from all seven respondents, and these responses accounted for 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 just ranges derived from customer and supplier specifications. During the past several decades, there has been a general movement in the United States toward the use of higher quality fluorspar by many of the consuming industries. 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 decreased by 6% in 2008 compared with that of 2007. Consumption of acid grade for HF and AlF_3 decreased by about 8% to 429,000 t, while consumption of fluorspar for metallurgical and other uses increased by 2% (table 2).

Acid-grade fluorspar, which accounted for 93% of the total U.S. fluorspar consumption, was used primarily as a feedstock in the manufacture of HF. Two companies reported fluorspar consumption for the production of HF in 2008, E.I. du Pont de Nemours & Co. Inc. (DuPont) and Honeywell International

Inc. Fluorspar consumption for HF production decreased by 4% compared with that of 2007. Since most acid-grade fluorspar is converted to HF before consumption, it is necessary to discuss HF uses and markets in order to properly analyze 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 an estimated 55% of domestic HF consumption. They were produced in the United States by Arkema Inc., DuPont, Great Lakes Chemical Corp., Honeywell, INEOS Fluor Americas LLC, MDA Manufacturing Ltd., and Solvay Solexis Inc.

Acid-grade fluorspar was used in the production of AlF_3 and cryolite (Na_3AlF_6), which are the main fluorine compounds used in aluminum smelting. Alumina is dissolved in a bath that consists primarily of molten Na_3AlF_6, AlF_3, and fluorspar to allow electrolytic recovery of aluminum. Fluorine losses are made up entirely by the addition of AlF_3, the majority of which will react with excess sodium from the alumina to form Na_3AlF_6.

Most AlF_3 is produced directly from acid-grade fluorspar or from byproduct FSA. In 2008, Alcoa World Alumina LLC (a business unit of Alcoa Inc.) produced AlF_3 from fluorspar at its plant at Point Comfort, TX. Alcoa shut down this plant in fall 2008 deciding to rely on imports for its AlF_3 needs. The plant, which was built in the early 1960s, had a capacity of 60,000 metric tons per year (t/yr) of AlF_3 and was the third leading consumer of fluorspar in the United States (David Cahill, Alcoa World Alumina LLC, written commun., January 9, 2009). As a result of the closure of the Point Comfort AlF_3 plant, Alcoa's consumption of fluorspar decreased by about 29% compared with that of 2007.

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 rail car, truckload, and less-than-truckload quantities. In 2008, this merchant market totaled 77,400 t, which included sales of 43,600 t of acid grade (56% of the merchant market) and sales of 33,800 t of metallurgical grade (44% of the merchant market). 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.

In the United States, consumption of fluorspar in metallurgical markets (mainly steel) increased by 25% compared with that of 2007. Metallurgical-grade consumption accounted for nearly all of the overall increase in metallurgical consumption. Consumption in this sector was 69% metallurgical grade and 31% acid grade.

In 2008, byproduct FSA sold for water fluoridation was about 53,500 t valued at $7.07 million, and about 9,300 t valued at $7.1 million was sold or used for AlF_3 or other uses.

Stocks

Data for stocks were available from some fluorspar distributors and HF and AlF_3 producers. Known consumer and distributor stocks at the end of 2008 totaled about 115,000 t. This represented a 27% increase in known consumer and distributor stocks from the end of the previous year. The last sales from the National Defense Stockpile were made in 2006, and Government stocks of fluorspar were zero.

Transportation

The United States depends on imports for the majority of its fluorspar supply. Fluorspar is transported to customers by truck, rail, barge, and ship. Metallurgical grade 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 is shipped routinely 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 is marketed in bags for small users and shipped by truck.

Ocean freight rates remained high during the first half of 2008, but declined sharply in the second half of the year. The Baltic dry index (BDI) fell from a peak of around 11,000 in May to 2,000 by yearend (Hayley-Bell, 2008). The BDI tracks worldwide international shipping prices of handymax, panamax, and capesize dry bulk carriers.

Prices

In recent years, the import values [cost, insurance, and freight (c.i.f.)] for some acidspar imports have been underreported. As a result, average import values for acidspar are no longer listed in table 1.

In 2008, acid-grade fluorspar prices increased rather dramatically, almost doubling in some cases when compared with those of 2007 (table 3). At yearend, according to published prices, the average price range, U.S. Gulf of Mexico port, c.i.f., dry basis, for Chinese acid grade increased by a minimum of $225 per metric ton. The average range of prices for Mexican acid grade, free on board (f.o.b.) Tampico, increased by a minimum of $70 per ton and by a minimum of $190 per ton for low-arsenic acid grade. The South African price range for acid grade, f.o.b. Durban, increased by a minimum of $46 per ton (Industrial Minerals, 2008c). Prices for metallurgical-grade fluorspar listed in table 3 were calculated from fourth-quarter statistics from the U.S. Census Bureau.

Foreign Trade

In 2008, U.S. exports of fluorspar increased by 39% to 18,800 t (table 4). With the disposal of all fluorspar stocks in the National Defense Stockpile and only a small amount of mined fluorspar, exports are likely reexports of imported material. About 47% (8,780 t) of exported fluorspar went to Taiwan, with an additional 4,280 t listed as exported to China. This additional material likely was shipped to Taiwan also, so Taiwan's percentage of U.S. exports may actually be 69%.

In 2008, imports for consumption of fluorspar decreased by about 8% compared with those of 2007 (table 5). The leading suppliers of fluorspar to the United States were Mexico (57%), China (32%), and South Africa (10%).

In 2008, owing to elevated Chinese acidspar prices coupled with high ocean freight rates, U.S. fluorspar consumers reduced purchases from China and replaced them with increased purchases from Mexico. This continued a trend that began in 2007. Mexico accounted for 50% of acidspar imports (41% in 2007); China, 37% (48% in 2007); and South Africa, 11% (7% in 2007).

In recent years, the c.i.f. import values for some acid-grade fluorspar imports have been underreported. Quantities as reported in table 5 are thought to be reasonably accurate, but the accompanying values reported for acid-grade imports at some customs districts appear to be low.

Imports of HF decreased by about 13% to 133,000 t (table 6). Imports of synthetic and natural Na_3AlF_6 increased by 71% to 7,650 t (table 7). Imports of AlF_3 increased by 73% to 47,600 t; China (61%) and Canada (32%) accounted for the bulk of imports (table 8). The increase in AlF_3 imports was necessitated by closure of Alcoa World Alumina's AlF_3 plant in fall 2008. AlF_3 import levels have increased by 500% since 2006.

World Review

World fluorspar production increased by 5% compared with that of 2007. Increased production in Kenya, Mexico, and South Africa and an estimated increase in China accounted for the bulk of the increase.

Canada.—Burin Fluorspar Ltd. (Alberta) signed an agreement in principle with British Columbia-based Rivera Capital Corp. proposing to merge the two companies with the goal of restarting fluorspar mining near St. Lawrence, on the Burin Peninsula of Newfoundland. The net result of a merger would be the public listing of Burin Fluorspar on the Toronto [Ontario] Stock Exchange Venture Exchange. Before the merger takes place, shareholders of both companies must approve the transaction. Prior to signing the agreement, Burin Fluorspar raised more than $6 million to fund a drilling program, prepare a bankable feasibility study, and complete other necessary work to determine whether the project is viable (Herridge, 2008).

As part of the project to restart fluorspar mining, Burin Fluorspar's subsidiary Burin Minerals Ltd. (Newfoundland and Labrador) hired Cabo Drilling Corp. (North Vancouver, British Columbia) to drill 15,000 meters (m) on Burin's St. Lawrence fluorspar property. Drilling commenced on June 11 and was completed in November (Cabo Drilling Corp., 2008). In December, work began on the design of the mine, mill, and wharf and on the project's feasibility study (scheduled for completion in September 2009). The projected mill capacity was 120,000 to 180,000 t/yr of acid-grade fluorspar, and the proposed schedule called for mine and mill production to begin in mid-2011 (Canada Fluorspar, Inc., 2009).

The Burin Peninsula area has a long mining history; the St. Lawrence fluorspar mines operated from 1933 to 1977 and from 1984 to 1990. Burin Fluorspar, which was issued mining leases in 1996 by the Provincial government, has performed exploratory drilling and prepared prefeasibility studies but has heretofore been unsuccessful in raising sufficient financing to restart mine production.

Kenya.—Kenya Fluorspar Co. Ltd. (Nairobi), which operates a fluorspar mine in the Kerio Valley in northwestern Kenya, reported that its export operations were disrupted in January and February by postelection violence resulting from the disputed national election. Mine production was unaffected, but Kenya Fluorspar's road and rail logistics linking the mine to the Port of Mombasa were adversely affected. Export activities had returned to normal by April (Industrial Minerals, 2008b).

Kenya Fluorspar announced that it had expanded its markets by securing orders from two European fluorochemical manufacturers. Kenya Fluorspar previously shipped most of its product to India. The company invested $1.8 million in port and mine improvements that included an upgrade to the crushing equipment, a new laboratory, and improved environmental compliance (allAfrica.com, 2008).

Mexico.—Mexichem S.A.B. de C.V., which is Mexico's primary producer of fluorspar and HF through its Mexichem Fluor division, announced the acquisition of Mexican fluorspar producer Fluorita de Rio Verde S.A. de C.V. The acquisition included mining concessions Lilia II and La Esperanza and production plants in the municipalities of Rio Verde, State of San Luis Potosi, and Alamos de Martinez, State of Guanajuato. Mexichem planned to begin production in the second unit at the Alamos de Martinez plant, which would increase Fluorita de Rio Verde's fluorspar production to 80,000 t/yr from 40,000 t/yr. Longer term plans call for reactivating the Rio Verde fluorspar mine (Mexichem S.A.B. de C.V., 2008).

South Africa.—Sallies Ltd. (Pretoria) reported that it was mothballing its Buffalo Fluorspar Mine, which was treating tailings from fluorspar mining performed between 1974 and 1994. Fluorspar produced from the tailings was high in phosphorus—1,200 parts per million (ppm) compared with 400 ppm for the company's Witkop Fluorspar Mine—and Sallies found it difficult to market the high-phosphorus product at a reasonable price. Phosphorus is an undesirable contaminant in acidspar, and most HF producers have upper limits of 500 ppm in their purchase specifications. The Buffalo property contains substantial in-ground fluorspar reserves with similar CaF_2 content to Sallies' Witkop Mine, but the operation lacked mining infrastructure and would require the allocation of more power from Eskom Holdings Ltd., South Africa's public electricity utility, to exploit the reserves (Mathews, 2008). With the closure of Sallies' Buffalo fluorspar operation, the average quality of South African acidspar has improved, which may result in higher overall prices for South African acidspar.

Sephaku Holdings Ltd. (Centurion) announced results of fluorspar exploration work on two projects in South Africa. The Naauwpoort/Kromdraai project is adjacent to South Africa's leading fluorspar producer, Vergenoeg Mining Co. (Pty) Ltd., and reported a measured resource in excess of 8 Mt of ore grading 24.6% CaF_2. Sephaku identified the second project as the Plattekop deposit, which, according to company resource totals, contained an additional resource of 4 Mt. The Plattekop deposit is about 800 m south of the Vergenoeg deposit and is described as a relatively flat-lying cap to a hill. This cap comprises a body of fluorspar/iron mineralization 400 m by 200

m in area, averaging 18 m thick, and grading approximately 40% CaF_2. The company proposed construction of a 130,000-t/yr flotation plant that would be fed by a blend of ore from both deposits at 32% CaF_2 average feed grade. Determination of capital budget requirements was to begin shortly after the announcement and was expected to be completed by the end of the first quarter of 2009 (Mineweb, 2008).

Spain's Minerales y Productos Derivados S.A. (Minersa) was expected to replace Industries Chimiques du Fluor (Tunisia) as the major shareholder and technology partner in Alfluorco (Pty) Ltd. (South Africa). Minersa would own a 50% stake in Alfluorco, which continued to study the feasibility of constructing an HF and AlF_3 plant at Richards Bay, KwaZulu Natal Province. Vergenoeg and the state-owned Industrial Development Corp. each hold a 25% stake in the company. Minersa (a 30% shareholder in Vergenoeg) operates one of the leading HF and AlF_3 facilities in Europe. Completion of the bankable feasibility study was expected by the end of the year (van der Merwe, 2008). Construction of this facility is part of South Africa's plan to expand into the production of value-added fluorochemicals for domestic use and export, instead of simply being an exporter of fluorspar.

Sweden.—Tertiary Minerals plc (Macclesfield, United Kingdom) awarded a contract to a Canadian mining services company to complete an extensive program of mineral processing tests to evaluate the production of acid-grade fluorspar concentrates from Tertiary's Storuman fluorspar project in Sweden. The test work is a major component of an economic and technical scoping study that was scheduled for completion by yearend (Tertiary Minerals plc, 2008a). Tertiary completed a drilling program in spring 2008 designed to reinvestigate the deposit originally discovered in the 1970s by Gränges Aluminium AB (Sweden). The first round of assay results from 10 drill holes were received, and results were positive enough to warrant submission of an additional 138 samples for assay. According to the company, step-out holes suggested the potential for large extensions of the ore deposit in previously untested areas (Tertiary Minerals plc, 2008b).

United Kingdom.—In early 2008, Glebe Mines Ltd. (Stoney Middleton) submitted a planning application to the Peak District National Park Authority for the extraction of fluorspar. This would extend the existing Tearsall open pit on Bonsall Moor in Derbyshire, England. The proposal called for the extraction of approximately 660,000 t of fluorspar ore during a 6-year period and would include progressive restoration of the mined out area. On completion of mining, the site would be fully restored to agricultural use during the following year. The application received support from the local town council, but the company was still waiting for a decision from the Park Authority (Glebe Mines Ltd., 2008; Industrial Minerals, 2008a).

The Glebe Mines application received valuable support in the form of British Geological Survey Open Report OR/08/027, which was part of a larger project analyzing the need for nonenergy indigenous mineral production in England. The report described the uses of fluorspar and its importance to the British economy and downstream industries that it supports. The principal aims were to provide background information on fluorspar and its downstream industries, review their economic benefits, determine the need for indigenous production and the impacts of ceasing production, and consider environmental impacts of fluorspar mining (Lusty and others, 2008).

Outlook

Long-term demand for fluorspar will depend to a large degree on the competition for the future refrigeration market between fluorochemical and not-in-kind systems (ammonia, carbon dioxide, hydrocarbons, and so forth). Current fluorocarbons have high global warming potential (GWP) and are being targeted for phase out as part of an international response to climate change. Fluorochemical producers, such as Arkema, Du Pont, and Honeywell, are attempting to develop new compounds with low GWP that could replace existing fluorocarbons or fluorocarbon blends. Candidates include hydrofluoroolefin HFO-1234yf as a replacement for HFC-134a in automotive air conditioning, and HFO-1234ze as a replacement in aerosols, foam blowing, and refrigeration. These two compounds each have low GWP and rapidly break down in the atmosphere. Regardless of the effectiveness of compounds such as these, fluorochemicals are already losing some of their markets to not-in-kind replacements. The aluminum fluoride market and smaller niche markets for fluoroelastomers and fluoropolymers are likely to be more resilient once the global economy recovers.

China maintained its 2009 fluorspar export quota at 550,000 t, which was the same as that in 2008. Significant capacity expansions in other countries are not expected until at least 2010, and as a result, international fluorspar supplies are expected to remain tight. The worldwide recession has reduced demand for fluorspar, but because fluorspar was in short supply, the effect on prices has been small. Market conditions in 2009 may cause a reduction in acid-grade fluorspar prices compared with peak prices at the end of 2008. The price of Chinese acidspar may decrease further as a result of a possible elimination of the current 15% export tax on fluorspar. The Chinese Government announced that it would reduce export taxes to zero and give more financial support to exporters as it tries to increase its share of global trade in the current economic downturn (Gil, 2009).

References Cited

allAfrica.com, 2008, Kenya—Fluorspar enters European market despite Chinese competition: The East African [Nairobi, Kenya], September 15, 2 p. (Accessed September 15, 2008, at http://allafrica.com/stories/200809151112.html.)

Cabo Drilling Corp., 2008, Cabo to drill 15,000 meters for Burin Minerals: North Vancouver, British Columbia, Canada, Cabo Drilling Corp. news release, June 16, 1 p. (Accessed September 3, 2008, at http://www.marketwire.com/press_release/Cabo-Drilling-Corp-TSX-VENTURE-CBE-868920.html.)

Canada Fluorspar, Inc., 2009, Canada Fluorspar, Inc.: Markham, Ontario, Canada, Canada Fluorspar Inc. PowerPoint presentation, June, 29 p. (Accessed June 11, 2009, at http://www.canadafluorspar.com/CFIpwrptJune09.pdf.)

Gil, Luis, 2009, China to cut export tax to zero as part of stimulus: DailyFX Research, March 9, 1 p. (Accessed March 16, 2009, at http://www.dailyfx.com/story/market_alerts/fundamental_alert/China_To_Cut_Export_Tax_1236638584874.html.)

Glebe Mines Ltd., 2008, Tearsall—The planning application: Stoney Middleton, United Kingdom, Glebe Mines Ltd. (Accessed August 27, 2008, at http://www.tearsall.co.uk/.)

Hayley-Bell, Andrew, 2008, Dive, dive, dive: Industrial Minerals, no. 495, December, p. 74–75.

Herridge, Paul, 2008, Hurdles to overcome, says Burin Fluorspar Ltd. president: The Southern Gazette, March 6, 1 p. (Accessed May 28, 2008, at http://www.southerngazette.ca/index.cfm?sid=139923&sc=382.)
Industrial Minerals, 2008a, Glebe fluorspar application supported: Industrial Minerals, no. 491, August, p. 16.
Industrial Minerals, 2008b, Kenya Fluorspar back on track: Industrial Minerals, no. 487, April, p. 16.
Industrial Minerals, 2008c, Prices: Industrial Minerals, no. 495, December, p. 88.
Lusty, P.A.J., Brown, T.J., Ward, J., and Bloomfield, S., 2008, The need for indigenous fluorspar production in England: British Geological Survey Open Report OR/08/027, 29 p. (Accessed September 2, 2008, at http://www.bgs.ac.uk/mineralsuk/free_downloads/home.html#fluorspar.)
Mathews, Charlotte, 2008, Sallies to close fluorspar operation: Business Day, October 14, 2 p. (Accessed December 9, 2008 at http://www.businessday.co.za/articles/topstories.aspx?ID=BD4A862677.)
Mexichem S.A.B. de C.V., 2008, Mexichem S.A.B. de C.V. announces that it has acquired the shares and production plants of Fluorita de Rio Verde in Mexico: Mexichem S.A.B. de C.V. news release, April 7, 1 p. (Accessed April 15, 2008, at http://www.mexichem.com/web_mexichem/noti_pop_up1.php?id_comunicado=57.)
Mineweb, 2008, Sephaku confirms Kromdraai fluorspar resource: Mineweb, November 20, 1 p. (Accessed November 20, 2008, at http://www.mineweb.net/mineweb/view/mineweb/en/page674?oid=73462&sn=Detail.)
Tertiary Minerals plc, 2008a, Contract awarded for mineral processing testwork on Storuman fluorspar project: Macclesfield, United Kingdom, Tertiary Minerals plc news release, July 8, 2 p. (Accessed September 10, 2008, via http://www.tertiaryminerals.com/.)
Tertiary Minerals plc, 2008b, Drilling results confirm Storuman fluorspar deposit extends for at least 2 km along strike: Macclesfield, United Kingdom, Tertiary Minerals plc news release, September 2, 3 p. (Accessed September 10, 2008, via http://www.tertiaryminerals.com/.)
van der Merwe, Christy, 2008, Spain's Minersa to become main shareholder in SA hydrofluoric acid joint venture: Creamer Media's Mining Weekly Online, July 22, 1 p. (Accessed September 3, 2008, at http://www.miningweekly.com/article.php?a_id=138625.)

GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publications

Fluorspar. Ch. in Mineral Commodity Summaries, annual.
Fluorine. Ch. in United States Mineral Resources, Professional Paper 820, 1973.
Fluorspar. Mineral Industry Surveys, quarterly.
Geology and Resources of Fluorine in the United States. Professional Paper 933, 1976.

Other

Chemical and Engineering News.
Chemical Week.
Economics of Fluorspar, The. Roskill Information Services Ltd., 2009.
Fluorspar. Ch. in Industrial Minerals and Rocks (7th ed.), Society for Mining, Metallurgy, and Exploration, Inc., 2006.
Fluorspar. Ch. in Mineral Facts and Problems, U.S. Bureau of Mines Bulletin 675.
Fluorspar and Inorganic Fluorine Compounds. Chemical Economics Handbook Marketing Research Report, SRI International, 2009.
ICIS Chemical Business Americas.
Industrial Minerals.
World Fluorochemicals to 2009. The Freedonia Group, 2005.

TABLE 1
SALIENT FLUORSPAR STATISTICS[1, 2]

		2004	2005	2006	2007	2008
United States:						
Exports:[3]						
Quantity	metric tons	20,600	36,100	13,000	13,600	18,800
Value[4]	thousands	$3,200	$7,840	$2,430	$2,650	$3,340
Imports:[3]						
Quantity	metric tons	599,000	629,000	553,000	620,000	572,000
Value[5]	thousands	$95,300	$122,000	$112,000	$111,000	$133,000
Average value:[5]						
Acid grade	dollars per metric ton	167	202	217	(6)	(6)
Metallurgical grade	do.	83	93	101	111	107
Consumption:						
Reported	metric tons	618,000	582,000	523,000	539,000	506,000
Apparent[7]	do.	691,000	616,000	608,000	613,000	529,000
Stocks, December 31:						
Consumer and distributor	do.	105,000 [8]	131,000 [8]	89,900 [8]	90,100	115,000
Government stockpile	do.	83,400	35,200	8,110	1,450	--
World, production	do.	5,220,000 [r]	5,410,000 [r]	5,730,000 [r]	5,750,000 [r]	6,040,000

[r]Revised. do. Ditto. -- Zero.

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

[2]Does not include fluorosilicic acid production or imports of hydrofluoric acid and cryolite.

[3]Source: U.S. Census Bureau; may be adjusted by the U.S. Geological Survey.

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

[5]Average unit value for the year, includes cost, insurance, and freight values at U.S. ports.

[6]Value data for acid-grade fluorspar imports appear to be underreported; accurate average value calculations cannot be made.

[7]Imports minus exports plus adjustments for changes in stocks held by Government and three leading consumers.

[8]Includes fluorspar purchased from the National Defense Stockpile (NDS) but still located at NDS depots.

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

(Metric tons)

End use or product	Containing more than 97% calcium fluoride		Containing not more than 97% calcium fluoride		Total	
	2007	2008	2007	2008	2007	2008
Hydrofluoric acid and aluminum fluoride	464,000	429,000	--	--	464,000	429,000
Metallurgical	14,800	14,900	24,300	33,800	39,000	48,700
Other[2]	28,400	28,700	8,270	--	36,600	28,700
Total	507,000	472,000	32,500	33,800	539,000	506,000
Stocks, consumer, December 31[3]	78,200	94,300	11,900	20,500	90,100	115,000

-- Zero.

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

[2]May include acid grade or metallurgical grade used in enamel, glass and fiberglass, steel castings, and welding rod coatings.

[3]Stocks are from hydrofluoric acid and aluminum fluoride producers and major distributors.

TABLE 3
PRICES OF IMPORTED FLUORSPAR

(Dollars per metric ton)

Source and grade	2007	2008
Acidspar:		
Chinese, dry basis, cost, insurance, and freight (c.i.f.) Gulf port, filtercake	305-310	530-550
Mexican, free on board (f.o.b.) Tampico, filtercake	180-200	250-325
Mexican, f.o.b. Tampico, arsenic <5 parts per million	210-220	400-420
South African, f.o.b. Durban, filtercake	175-204	250
Metspar, Mexican, c.i.f. port of U.S. entry, metspar[1]	110	108

[1]Metspar prices are the average value per metric ton of imported Mexican metspar for the fourth quarter calculated from the U.S. Census Bureau statistics.

Sources: Industrial Minerals, no. 483, December 2007, p. 76; no. 495, December 2008, p. 88.

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

Country	2007		2008	
	Quantity (metric tons)	Value[2]	Quantity (metric tons)	Value[2]
Australia	5	$3,060	15	$7,200
Brazil	--	--	22	3,120
Canada	6,000	1,470,000	4,870	1,270,000
China	--	--	4,280	621,000
Dominican Republic	558	113,000	524	95,000
India	34	10,000	24	7,000
Indonesia	--	--	5	2,860
Israel	--	--	15	4,500
Korea, Republic of	--	--	72	18,000
Malaysia	--	--	15	9,630
Mexico	--	--	29	3,200
Netherlands	3	2,910	30	4,400
Philippines	23	2,590	161	18,000
Taiwan	6,930	1,040,000	8,780	1,280,000
Total	13,600	2,650,000	18,800	3,340,000

-- 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	2007 Quantity (metric tons)	2007 Value[2] (thousands)	2008 Quantity (metric tons)	2008 Value[2] (thousands)
Containing more than 97% calcium fluoride (CaF_2):				
China:				
Anchorage, AK	41	$8	--	--
Cleveland, OH	--	--	3,720	$1,540
Great Falls, MT	--	--	6	15
Houston, TX	193,000	37,600	117,000	39,100
New Orleans, LA	83,900	18,900	63,200	26,400
Total	277,000	56,500	184,000	67,100
Germany, Savannah, GA	--	--	133	17
Mexico:				
Laredo, TX	61,000	13,800	74,100	18,600
New Orleans, LA	174,000	23,600	175,000	23,400
Total	235,000	37,300	249,000	42,000
Mongolia:				
Houston, TX	23,800	4,450	--	--
New Orleans, LA	--	--	5,500	2,100
Total	23,800	4,450	5,500	2,100
Russia, Philadelphia, PA	--	--	1	7
South Africa:				
Great Falls, MT	--	--	258	106
Houston, TX	30,800	5,150	51,100	12,000
New Orleans, LA	10,600	2,840	5,360	1,960
Total	41,400	7,990	56,700	14,100
United Kingdom:				
Houston, TX	31	37	55	51
Los Angeles, CA	345	42	588	69
Total	376	79	643	120
Grand total	577,000	106,000	496,000	125,000
Containing not more than 97% CaF_2:				
Mexico:				
Charleston, SC	3,030	345	--	--
Laredo, TX	2,440	232	5,100	522
New Orleans, LA	36,700	4,090	70,100	7,510
Total	42,100	4,670	75,200	8,040
Namibia:				
Charleston, SC	191	17	283	26
Houston, TX	278	24	519	45
Total	469	41	802	71
South Africa, New York, NY	37	8	--	--
Grand total	42,600	4,720	76,000	8,110
Grand total, all grades	620,000	111,000	572,000	133,000

-- 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; may be adjusted by the U.S. Geological Survey.

TABLE 6

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

Country	2007 Quantity (metric tons)	2007 Value[2] (thousands)	2008 Quantity (metric tons)	2008 Value[2] (thousands)
Canada	31,500	$49,500	23,900	$48,400
China	2,120	1,970	1,690	2,430
France	--	--	(3)	2
Germany	427	1,010	562	1,420
India	177	192	71	142
Japan	1,080	2,340	1,240	2,520
Liechtenstein	(3)	6	1	90
Mexico	116,000	121,000	105,000	117,000
Peru	61	31	--	--
Singapore	48	97	79	209
Taiwan	--	--	34	133
United Kingdom	3	11	(3)	5
Total	152,000	176,000	133,000	172,000

-- 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	2007 Quantity (metric tons)	2007 Value[2] (thousands)	2008 Quantity (metric tons)	2008 Value[2] (thousands)
Belgium	36	$37	--	--
Canada	2	7	398	$118
China	1,060	960	1,590	1,460
Denmark	709	532	450	416
Germany	2,210	2,140	2,280	2,440
Hungary	265	256	345	382
Japan	149	205	2,450	3,200
Turkey	--	--	20	4
United Kingdom	19	26	120	160
Other[3]	25 r	44 r	1	9
Total	4,470	4,200	7,650	8,180

rRevised. -- 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]Includes Bulgaria (2007), India, and Italy (2007).

Source: U.S. Census Bureau.

TABLE 8

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

Country	2007 Quantity (metric tons)	2007 Value[2] (thousands)	2008 Quantity (metric tons)	2008 Value[2] (thousands)
Canada	10,800	$12,900	15,400	$21,100
China	8,650	11,800	28,900	44,500
Italy	266	410	102	149
Japan	9	23	65	201
Mexico	4,130	4,220	1	9
Other[3]	3,750	3,950	3,100	3,400
Total	27,600	33,300	47,600	69,400

[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 Brazil, Germany, Sweden, Switzerland, and the United Kingdom.

Source: U.S. Census Bureau.

TABLE 9

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

(Metric tons)

Country and grade[3, 4]	2004	2005	2006	2007	2008
Argentina	6,437	7,502	8,278	9,735 r	9,500 e
Brazil, marketable:					
Acid grade	40,948	42,043 r	41,373 r	44,869 r	45,000 p
Metallurgical grade	16,824	24,469 r	22,231 r	20,657 r	20,700 p
Total	57,772	66,512	63,604	65,526 r	65,700 p
China:[e]					
Acid grade	1,600,000	1,650,000	1,800,000	1,850,000	1,900,000
Metallurgical grade[5]	1,100,000	1,150,000	1,300,000	1,350,000	1,350,000
Total	2,700,000	2,800,000	3,100,000	3,200,000	3,250,000
Egypt	891 r	549 r	550 r, e	550 r, e	550 e
France:[e, 6]					
Acid and ceramic grades	80,000	80,000	35,000	--	--
Metallurgical grade	10,000	10,000	5,000	--	--
Total	90,000	90,000	40,000	--	--
Germany, acid grade	33,203	35,364	53,009	54,359 r	51,200 e
India:[e, 7]					
Acid grade	4,300	4,400	500	1,000	1,500
Metallurgical grade	6,400	6,500	5,800 r	5,000	5,500
Total	10,700	10,900	6,300 r	6,000	7,000
Iran[8]	54,052	64,601	65,000 e	65,000 e	65,000 e
Italy[6]	17,915	15,000 e	8,000 e	--	--
Kazakhstan	4,000	4,750	30,000 r, e	64,000 r	66,300
Kenya, acid grade	108,000	97,261	83,428	82,000	98,248
Korea, North, metallurgical grade[e]	12,000	12,500	12,500	12,500	12,500
Kyrgyzstan[e]	4,000	4,000	4,000	4,000	4,000
Mexico:[9]					
Acid grade	401,753	324,568	466,000	513,000 e	630,000 e
Metallurgical grade	440,945	550,882	470,000	420,000 e	428,000 e
Total	842,698	875,450	936,000	933,000 e	1,058,000
Mongolia:					
Acid grade	148,200	134,100	137,600	131,000 r	130,000 e
Other grades[10]	206,700	233,400	255,000	250,000	250,000 e
Total	354,900	367,500	392,600	381,000 r	380,000 e
Morocco, acid grade	112,100	114,740	94,254	78,900	60,700
Namibia, acid grade[11]	96,400	105,700	121,700	109,300	108,800
Pakistan, metallurgical grade[e]	1,026 [12]	1,040	2,839 r, [12]	1,500 r	1,400
Romania, metallurgical grade[e]	15,000	15,000 r	15,000 r	15,000 r	15,000

See footnotes at end of table.

TABLE 9—Continued

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

(Metric tons)

Country and grade[3, 4]	2004	2005	2006	2007	2008
Russia	226,400	245,500	210,000 e	180,000 e	269,000 e
South Africa:[e, 13]					
Acid grade	250,000	250,000 r	240,000	268,000 r	301,000
Metallurgical grade	15,000	16,000 r	16,000	17,000 r	15,000
Total	265,000	266,000	256,000	285,000	316,000
Spain:					
Acid grade	135,505	133,495	135,864 r	132,753 r	133,000 p
Metallurgical grade	10,186	10,500	17,241 r	16,279 r	16,300 p
Total	145,691	143,995	153,105 r	149,032 r	149,300 p
Tajikistan[e]	9,000	8,500	8,500	8,500	8,500
Thailand, metallurgical grade	2,375	295	3,240	1,820	1,800 e
Turkey, metallurgical grade	-- r	-- r	--	-- r	--
United Kingdom[e]	50,080 [12]	60,980 [12]	60,000	40,000	45,000
Grand total	5,220,000 r	5,410,000 r	5,730,000 r	5,750,000 r	6,040,000

[e]Estimated. [p]Preliminary. [r]Revised. -- 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 May 26, 2009.

[3]In addition to the countries listed, Bulgaria is thought to have produced fluorspar in the past, but production is not officially reported, and available information is inadequate for the formulation of reliable estimates of output levels.

[4]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.

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

[6]Mine closed in 2006.

[7]Year beginning April 1 of that stated.

[8]Year beginning March 21 of that stated. Data for 2004 and 2005 are reported by Iranian Mines and Mining Development and Renovation Organization.

[9]Data are reported by Servicio Geológico Mexicano, quantities by grade may be estimated.

[10]Principally submetallurgical-grade material.

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

[12]Reported figure.

[13]Based on data from the South African Minerals Bureau; data show estimated proportions of acid-, ceramic-, and metallurgical-grade fluorspar within the reported totals.