# FLUORSPAR

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Traditionally, fluorspar has been considered to be vital to the Nation's national security and economy. It is used directly or indirectly to manufacture such products as aluminum, gasoline, insulating foams, refrigerants, steel, and uranium fuel. Most fluorspar consumption and trade involve either acid grade, which is greater than 97% calcium fluoride (CaF<sub>2</sub>), or subacid grade, which is 97% or less CaF<sub>2</sub>. The latter includes metallurgical and ceramic grades and is commonly called metallurgical grade.

All domestic sources of fluorspar are derived from sales of material from the national defense stockpile (NDS) and from a small amount of synthetic fluorspar produced from industrial waste streams. Byproduct fluorosilicic acid production from some phosphoric acid producers supplements fluorspar as a domestic source of fluorine, but is not included in fluorspar production or consumption calculations. According to the U.S. Census Bureau and the U.S. Geological Survey (USGS), imports of fluorspar increased by 9% compared with those of 1999. Hydrofluoric acid (HF) imports also increased by 9% when compared with those of 1999.

#### **Legislation and Government Programs**

In accordance with the Strategic and Critical Materials Stock Piling Act as amended (50 U.S.C. 98h-2), the Defense National Stockpile Center (DLA-DNSC) of the Defense Logistics Agency was authorized to sell about 54,400 metric tons (t) (60,000 short dry tons) of metallurgical-grade fluorspar during fiscal year 2000 (October 1, 1999, to September 30, 2000). During calendar year 2000, the DLA-DNSC sold about 54,400 t (60,000 short dry tons) of metallurgical grade. According to the DLA-DNSC's fiscal year 2001 (October 1, 2000, to September 30, 2001) annual materials plan, total sales of about 54,400 t (60,000 short dry tons) of metallurgical grade were authorized. See the section on stocks for unsold quantities remaining in the NDS.

#### Production

In 2000, there was no reported domestic mine production of fluorspar, and there is no data survey for byproduct fluorspar. Domestic production data for fluorosilicic acid were developed by the USGS from voluntary surveys of U.S. operations. Of the 11 fluorosilicic acid operations surveyed, 10 respondents reported production, and 1 respondent reported zero production, representing 100% of the quantity reported.

Hastie Mining Co. washed, screened, and dried metallurgicaland acid-grade fluorspar imported or purchased from the NDS. Seaforth Mineral & Ore Co., Inc., dried and screened imported or NDS fluorspar at its facilities at Cave-In-Rock, IL, and East Liverpool, OH, as did Applied Industrial Materials Corp. at its facility at Aurora, IN.

In 2000, 6 companies operated 10 plants that processed phosphate rock for the production of phosphoric acid, that generated 68,000 t of byproduct fluorosilicic acid. They sold or used 67,800 t of byproduct fluorosilicic acid at a value of about \$10 million. This was equivalent to approximately 119,000 t of fluorspar (grading 92% CaF<sub>2</sub>) sold or used. This was essentially unchanged from the level of fluorosilicic acid output reported in 1999. Because fluorosilicic acid is a byproduct of the

#### Fluorspar in the 20th Century

In 1900, U.S. fluorspar production was 16,700 metric tons, with more than 80% of it mined in Caldwell, Crittenden, and Livingston Counties in Kentucky. The remainder of the output came from the well-known mining district near Rosiclare in Hardin County, IL. Processing of the product simply consisted of washing and screening, although in 1900, two producers were building facilities to grind the fluorspar prior to sale. In 1920, the floation process was introduced, which allowed production of fluorspar of more than 97% purity, which became known as acid-grade fluorspar. At the beginning of the 20th century small amounts of fluorspar were consumed for ceramics, enamels, foundry work, glass, hydrofluoric acid, and steel. Since the introduction of the open hearth furnace to the United States in 1888, however, the use of fluorspar as a flux in steelmaking had been increasing.

For most of the century, demand for fluorspar grew steadily, driven during the first quarter of the century almost entirely by the steel market and, from the 1930s on, by the steel market and the development of chlorofluorocarbons (CFCs), which provided a new market for hydrofluoric acid (HF). Demand peaked in 1974, when U.S. consumption reached 1.38 million metric tons, at which time about 55% of consumption was acid-grade fluorspar and 45% was metallurgical-grade fluorspar. During the last quarter of the century, fluorspar's use in steelmaking decreased dramatically, and CFC production was discontinued for environmental reasons. By the end of the century, domestic annual consumption of fluorspar had leveled off in the 500,000- to 600,000-ton range, with consumption for HF production accounting for about 80% of apparent consumption. During the 20th century, the U.S. fluorspar mining industry grew substantially and reached peak production during World War II, when shipments reached 375,000 tons in 1944. The postwar years would see the beginning of a trend of decreasing domestic production and increasing imports; by the end of the century domestic mining of fluorspar had ceased entirely.

phosphate fertilizer industry and is not manufactured for itself alone, shortages may occur when phosphate fertilizer production goes down.

Some synthetic fluorspar was recovered as a byproduct of uranium processing, petroleum alkylation, and stainless steel pickling. The majority of the marketable product was estimated to come from uranium processing. At present, an estimated 5,000 to 8,000 t of synthetic fluorspar is produced annually in the United States.

#### Environment

The U.S. Environmental Protection Agency (EPA) released a review draft of its report titled "Estimates of U.S. Emissions of High-Global Warming Potential Gases and the Costs of Reductions." The preliminary draft report presented current forecasts of emissions of high-global-warming-potential gases (HGWPG) in the United States and assembled the available cost and market information on the technologies that could reduce these emissions. Using this information, marginal abatement curves were generated that attempted to quantify the achievable emission reductions at increasing values for carbon. The preliminary draft was released to solicit comments and additional information on the costs of reducing emissions of the HGWPG, which include hydrofluorocarbons (HFCs), perfluorocarbons, and sulfur hexafluoride (U.S. Environmental Protection Agency, March 2000, Estimates of U.S. emissions of high-global warming potential gases and the costs of reductions, accessed July 26, 2000, at URL http://www.epa.gov/ghginfo/ new.htm).

#### Consumption

Domestic consumption data for fluorspar were developed by the USGS from voluntary surveys of U.S. operations (table 2). The consumption survey was sent to 40 operations quarterly and to 3 small operations annually. In 2000, on average, 35 operations responded to the consumption surveys, representing 88% of those operations surveyed. These respondents accounted for 98% of the reported U.S. consumption. Estimates for nonrespondents were based on past consumption levels, trends, and nonsurvey sources. Owing to the existence of additional consumers that are not surveyed, the reported consumption figures are estimated to constitute about 87% of the actual U.S. annual consumption.

Traditionally, there have been three grades of fluorspar: acid grade, containing more than 97%  $CaF_2$ ; ceramic grade, containing 85% to 95%  $CaF_2$ ; and metallurgical grade, containing 60% to 85% or more  $CaF_2$ . During the past several decades, there has been a general movement 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. The following is a discussion of the general uses of fluorspar by grade and, in the case of acid grade, the uses of some of its important downstream products.

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

The largest use of HF was for the production of a wide range of fluorocarbon chemicals, including HFCs,

hydrochlorofluorocarbons (HCFCs), and fluoropolymers. HCFCs and HFCs were produced by the following eight companies: ATOFINA Chemicals, Inc. (formerly Elf Atochem North America, Inc.); Ausimont USA, Inc.; DuPont; Great Lakes Chemical Corp.; Honeywell; INEOS Fluor Americas LLC (formerly I.C.I. Americas, Inc.); La Roche Chemicals, Inc.; and MDA Manufacturing Ltd. MDA is a joint venture between Daikin America Inc. and 3M Corp. to produce HCFC 22 and hexafluoropropane for captive use in fluoropolymer manufacturing.

Some of the existing or potential fluorocarbon replacements for the banned chlorofluorocarbons (CFCs) are HCFCs 22, 123, 124, 141b, 142b, and 225. These HCFC substitutes have ozonedepletion potentials that are much lower than those of CFCs 11, 12, and 113, which together had accounted for more than 90% of CFC consumption. HCFC 22 has been used as a highpressure refrigerant (e.g., in home air conditioning) for years; HCFC 123 is being used as a replacement for CFC 11 in lowpressure centrifugal chillers; HCFC 124 is a potential replacement for CFC 114 in medium-pressure centrifugal chillers and for CFC 12 as a diluent in sterilizing gas; and HCFCs 141b and 142b have replaced most of the CFCs 11 and 12 used in foam blowing. HCFCs 141b and 225, perfluorocarbons, and hydrofluoroethers have been introduced as replacements for CFC solvents. However, because of the current phaseout schedule for HCFCs, the market for HCFCs will exist for only a short time, and perfluorocarbons are on the list of gases that contribute to global warming. Of most immediate concern is the ban on production and importation of HCFC 141b, which is scheduled to go into effect January 1, 2003.

The HFC replacements have no ozone-depletion potential because they contain no chlorine atoms. The most successful HFC replacement compound is HFC 134a. It is the main replacement for CFC 12 in automobile air conditioners and is being used as the refrigerant in new commercial chillers and refrigerators and as the propellant in aerosols and tire inflators. HFCs 23, 32, 125, 143a, and 152a also are being produced domestically but in much smaller quantities. These HFCs hold potential for use individually or, more likely, in blends for specific uses, such as the azeotropic mixture of HFCs 32 and 125 that is emerging as the replacement of choice for HCFC 22. HFCs 134a and 227ea are being evaluated for use in medical aerosols. In 2000, Great Lakes Chemical and ICI Klea (now part of INEOS Fluor) announced that they were forming a joint venture to manufacture and supply HFC 227ea for use in measured dose inhalers. The new facility will be located at Great Lakes' facility in southern Arkansas (ICI Klea, February 9, 2000, INEOS Fluor in rally across Africa, accessed February 22. 2000. at URL http://www.klea.co.uk/news/ view.cfm?id=51). HFC 227 also is an alternative to CFC 114, while HFC 245ca and HFC 356 are identified as possible longterm replacements for CFC 11 in chillers and for CFC 114 in high-temperature heat pumps. HFC 245fa may be a candidate for use as a low-pressure refrigerant to replace HCFC 123.

HFCs 134a, 245fa, 356, and 365mfc are being tested as potential replacements for HCFC 141b in blowing agents for thermosets, such as polyurethane. HFC 245fa appears to be further along in its development, and Honeywell has started construction of a new facility in Geismar, LA, to produce HFC 245fa for use in a range of foam-blowing applications in rigid polyurethane and polyisocyanurate foam insulation (Chemical Market Reporter, 2000). In competing technology, ATOFINA announced the development of new technology to improve polyurethane foams manufactured with HFC 134a and other gaseous blowing agents. The new technology allows use of up to 75% HFC 134a while yielding foams similar to those blown with HCFC 141b. Further development and testing are required to confirm the commercial performance of the foams (ATOFINA Chemicals, Inc., January 24, 2001, ATOFINA Chemicals, Inc. announces development of improved technology for HFC-134a in insulation foam applications, accessed May 24, 2001, via URL

http://www.atofinachemicals.com/whatsnew).

HFC 4310 has been developed as a replacement for CFC 113, HCFCs, and perfluorocarbons for use in drying fluids, cleaning and rinsing agents, defluxing agents, and heat-transfer media. DuPont has introduced a range of new specialty cleaning fluids for applications, including aerosol solvents, precision metal cleaning, defluxing and carrier fluids for applying lubricants. The new products are blends of HFC 4310 and HFC 365 that are stable, nonflammable, and have lower global warming potential than many previously existing products (Optical World, October 20, 2000, Cleaning fluid from DuPont, accessed June 15, 2001, at URL http://www.optical-world.co.uk/ October%202000%20optiproducts.htm).

HCFCs 22, 123, and 124; HFCs 23, 125, 134a, and 227ea; and a number of other fluorine compounds have been approved by EPA as acceptable substitutes (some subject to use restrictions) for halon streaming agents for fire suppression.

CFC 113, HCFCs 22 and 142b, and HFC 152a were produced as chemical intermediates in the production of fluoropolymers. Fluoropolymers have desirable physical and chemical properties that allow them to be used in products from pipes and valves to architectural coatings to cookware. These intermediate uses of CFC 113 and HCFCs 22 and 142b will not be subject to the production phaseouts mandated by the Montreal Protocol and the Clean Air Act Amendments of 1990 because these products are consumed in the manufacturing process.

HF was consumed in the manufacture of uranium tetrafluoride, which was used in the process of concentrating uranium isotope 235 for use as nuclear fuel and in fission explosives. It also was used in stainless steel pickling, petroleum alkylation, glass etching, treatment of oil and gas wells, and as a cleaner and etcher in the electronics industry. HF was used as the feedstock in the manufacture of a group of inorganic fluorine chemicals that include chlorine trifluoride, lithium fluoride, sodium fluoride, sulfur hexafluoride, tungsten hexafluoride, and others that are used in dielectrics, metallurgy, wood preservatives, herbicides, mouthwashes, decay-preventing dentifrices, and water fluoridation.

Acid-grade fluorspar was used in the production of aluminum fluoride (AlF<sub>3</sub>), which is the main fluorine compound used in aluminum smelting. In the Hall-Héroult aluminum process, alumina is dissolved in a bath of molten cryolite, AlF<sub>3</sub>, and fluorspar to allow electrolytic recovery of aluminum. On average worldwide, the aluminum industry consumes about 23 kilograms of fluorides (measured as AlF<sub>3</sub> equivalent) for each metric ton of aluminum produced, ranging from 10 to 12 kilograms per metric ton (kg/t) in a modern prebaked aluminum smelter to 40 kg/t in an older Soderberg smelter without scrubbers. AlF<sub>3</sub> was added to the electrolyte in reduction cells to improve the cells' electrical efficiency. It was used by the ceramic industry for some body and glaze mixtures and in the production of specialty refractory products, and in the manufacture of aluminum silicates and in the glass industry as a

filler. The AlF<sub>3</sub> manufactured for use in aluminum reduction cells is produced directly from acid-grade fluorspar or from byproduct fluorosilicic acid. About 82% of AlF<sub>3</sub> is produced from fluorspar and 18% from fluorosilicic acid (excluding China, the Commonwealth of Independent States, and Russia for which specific data are unavailable). In 2000, Alcoa World Chemicals, a business unit of Alcoa Inc., produced AlF<sub>3</sub> from fluorspar at Point Comfort, TX.

Ceramic-grade fluorspar was used by the ceramic industry as a flux and an opacifier in the production of flint glass, white or opal glass, and enamels. Ceramic grade was also used to make welding rod coatings and as a flux in the steel industry.

Metallurgical-grade fluorspar was used primarily as a fluxing agent by the steel industry. Fluorspar is added to the slag to make it more reactive by increasing its fluidity (by reducing its melting point) and thus increasing the chemical reactivity of the slag. Reducing the melting point of the slag brings lime and other fluxes into solution to allow the absorption of impurities. Fluorspar of different grades was used in the manufacture of aluminum, brick, cement, and glass fibers and by the foundry industry in the melt shop.

The U.S. steel industry reported high levels of production during the first half of 2000, but a slowing economy and increased imports resulted in a decrease in production of 11% in the second half. This was reflected in the industry's capacity utilization, which averaged 90% for the first half of the year but only 80% in the second half and by December had fallen to 72%. For the year, raw steel production was up by 4.2% (3.1% for basic oxygen process and 5.5% for electric arc process) compared with 1999.

The merchant-fluorspar market includes metallurgical-grade and acid-grade sales to steel mills, foundries, glass and ceramics plants, welding rod manufacturers, and other small markets in rail car, truckload, and less than truckload quantities. This merchant market is mature and in the United States amounts to about 115,000 metric tons per year (t/yr), equally divided between acid-grade and metallurgical-grade sales. Over the years, fluorspar usage in such industries as steel and glass has declined because of product substitutions or changes in industry practices.

The level of total reported fluorspar consumption was essentially unchanged in 2000 compared with that of 1999. Consumption of acid grade for HF and  $AlF_3$  was essentially unchanged, but consumption for other uses decreased by 14%, although the data collected for non-HF/AlF<sub>3</sub> markets are believed to be underreported and may not accurately reflect the true size of these markets.

About 33,700 t of byproduct fluorosilicic acid valued at \$4.98 million was sold for water fluoridation, about 20,400 t of fluorosilicic acid valued at \$2.28 million was sold to make  $AlF_3$  for the aluminum industry, and about 13,700 t valued at \$2.78 million was sold or used for other uses, such as sodium silicofluoride production.

#### Stocks

Consumer stocks at yearend totaled 73,900 t, which was a decrease of 18% from 1999 levels. Consumer and distributor stocks totaled of 289,000 t, which included 215,000 t purchased from the NDS but still located at NDS depots. As of December 31, 2000, the NDS fluorspar inventory classified as excess (excluding material sold pending shipment) contained only about 112,000 t (123,000 short dry tons) of metallurgical-grade

material. About 51% of the remaining metallurgical-grade material was classified as nonstockpile grade.

#### Transportation

The United States is import dependent 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 containing 7% to 10% moisture to facilitate handling and to reduce dust. Most acid-grade imports come from China and South Africa. Fluorspar is shipped by ocean freight using the "tramp" market for ships. Bulk carriers of 10,000 to 50,000 t deadweight normally are used. Participants negotiate freight levels, terms, and conditions.

#### Prices

According to Industrial Minerals magazine (London), yearend price ranges for Mexican fluorspar, free on board (f.o.b.) Tampico, were unchanged at \$110 to \$130 per metric ton for acid grade and \$85 to \$105 per ton for metallurgical grade, but increased to \$132 to \$145 per ton for low-arsenic acid grade (table 3). The range of South African prices for acid grade, f.o.b. Durban, remained unchanged at \$105 to \$125 per ton. No specific prices were available for Chinese fluorspar. According to Industrial Minerals magazine, the average U.S. Gulf port price, including cost, insurance and freight (c.i.f.), dry basis, for acid grade was \$130 to \$135 per ton. This would be the average delivered price of Chinese, Mexican, and South African acid grade at Gulf ports.

Prices of imported acid-grade fluorspar during the past 10 years have exhibited a roller-coaster pattern of highs and lows (figure 1). Prices have been affected by major factors, such as the severe drop in demand caused by the CFC phaseout, major increases in Chinese exports and the resulting cutthroat competition between Chinese exporters, and the introduction of Chinese export quotas and license fees. Lesser factors that affected prices were sales from the NDS and variations in shipping rates.

According to Chemical Market Reporter, the yearend 2000 price quotation for aqueous HF, 70%, in drums, f.o.b., freight allowed, was unchanged at \$0.65 per pound. The quotation for chemically pure (99.0 weight percent) anhydrous HF, 1,300 pounds, f.o.b., was unchanged at \$2.96 per pound. Quoted yearend prices for AlF<sub>3</sub> ranged from \$825 to \$1,408 per metric ton. Quoted prices for sodium fluoride, white, 97%, in 50- or 100-pound bags, drums, carloads, f.o.b. Tampa, was \$0.60 per pound, and \$0.63 per pound at El Paso. A price quote for fluorosilicic acid was unavailable.

#### **Foreign Trade**

According to the U.S. Census Bureau, U.S. exports of fluorspar decreased by 28% to 39,800 t from the 1999 figure (table 4). All U.S. exports were believed to be reexports of material imported into the United States or exports of material purchased from the NDS.

In 2000, imports for consumption of fluorspar increased by 9% when compared with those of 1999, according to the U.S. Census Bureau and USGS data (table 5). The largest suppliers

dollars per metric ton, was \$128 for acid grade and \$84 for metallurgical grade. There are no tariffs on acid-grade or subacid-grade (metallurgical-grade) fluorspar from normal-trade-relations countries. There are no tariffs on other major fluorida mine

(metallurgical-grade) fluorspar from normal-trade-relations countries. There are no tariffs on other major fluoride minerals and chemicals, such as natural or synthetic cryolite, hydrofluoric acid, and aluminum fluoride.

of fluorspar to the United States were, in descending order,

China, South Africa, and Mexico. China accounted for nearly 63% of U.S. fluorspar imports. The average c.i.f. unit value, in

Imports of HF increased by 9% to 131,000 t, or a quantity equivalent to about 196,000 t of fluorspar (table 6). Imports of synthetic and natural cryolite decreased by nearly 4% to 9,190 t, or a quantity equivalent to approximately 11,000 t of fluorspar (table 7). Imports of AlF<sub>3</sub> increased by 11% to 21,500 t, or a quantity equivalent to about 32,200 t of fluorspar (table 8).

#### World Review

World production increased by nearly 100,000 t compared with the revised 1999 data (table 9). Mexico (13%) and Mongolia (29%) reported the largest increases.

*Canada.*—In 2000, Canada imported 19,300 t of metallurgical-grade fluorspar and 161,000 t of acid-grade fluorspar. Total fluorspar imports increased by 6% compared to those of 1999. The major sources of supply were, in descending order, Mexico, Morocco, and China (Jane Currie, Minerals and Mining Statistics Division, Natural Resources Canada, written commun., 2001). The two major fluorspar consumers in Canada are the Honeywell HF plant at Amherstburg, Ontario, and Alcan Aluminium Ltd., which produces AlF<sub>3</sub> at its Vaudreuil refinery at Jonquière, Québec.

The previously announced merger between Canadian companies Burin Fluorspar Ltd. and Blue Desert Mining Inc. was unsuccessful. Shareholders had apparently approved the merger but delays in acquiring regulatory approval and the soft mining sector were given as reasons for the failure. Blue Desert had changed its name to Canada Fluorspar Inc. in anticipation of the expected merger, but Burin Fluorspar and Canada Fluorspar are in no way affiliated. Burin Fluorspar continued its attempts to arrange financing to reopen the mine and mill at St. Lawrence, Newfoundland, and to find a strategic jointventure partner to take partial ownership in the company (Burin Minerals Ltd., 2000).

*China.*—Determining China's actual production data for acid- and metallurgical-grade fluorspar has always been difficult owing to the lack of official Government data and the complex nature of the network of producers, processors, exporters, and consumers in China. Problems range from an unreliable breakdown of export data by grade to the lack of reliable information on domestic consumption levels, which may include more than 400,000 t/yr of submetallurgical-grade fluorspar for cement and glass manufacturing.

Although China's fluorspar production and export levels have remained fairly constant, there have been numerous plant and mine closures, openings, and consolidations in recent years resulting in the number of active mills decreasing to about 80 in 2000 from about 125 in 1997. As a result, the distribution of production across China has changed. Zhejiang Province continues to be a major producing area, but smaller producing provinces such as Hubei and Shandong have seen capacity plummet, while the southern provinces of Jujian and Jiangxi have reported dramatic increases in production (Industrial

#### Minerals, 2001).

In late 2000, the Chinese Ministry of Foreign Trade and Economic Cooperation held bidding for about 750,000 t of an expected total of 1.15 Mt of fluorspar authorized for export in 2001. There was about 395,000 t released under agreement bids at \$39 per ton and 350,000 t under open bid at about \$84 per ton. This averaged to about \$60 per ton, which was \$15 per ton higher than the average in 2000.

**European Union.**—After a review of the antidumping duties (established in December 1995) on imports of Chinese fluorspar in the form of filtercake or powder into the European Union (EU), the Council of the European Union determined that the duty should be maintained. The duty remains equal to the difference between a minimum price of 113.5 euros per dry ton and the net, free-at-Community-frontier price, before customs clearance (Industrial Minerals, 2000b).

After a 4-month series of conciliation talks between members of the European Parliament and EU Governments, a new timetable for the phaseout of HCFCs in the EU was approved. HCFCs may not be used in new refrigeration equipment after July 1, 2002, and after 2010, virgin HCFCs may not be used, even in existing refrigeration and air-conditioning equipment. Recycled HCFCs may be still be used as an alternative to virgin material from 2010 to 2015, at which time a total ban goes into effect (European Chemical News, 2000).

*France.*—The merger of Elf Aquitaine S.A. and TotalFina S.A., France's largest oil and gas companies, into the newlymerged group TotalFinaElf S.A., resulted in the reorganization of all chemical activities under the name ATOFINA S.A. Elf Atochem North America, Inc., a major producer of fluorochemicals for the foam blowing and refrigeration markets, was renamed ATOFINA Chemicals, Inc. The company will remain headquartered in Philadelphia, PA (ATOFINA Chemicals, Inc., June 19, 2000, Letter to customers—Elf Atochem North America, Inc., now ATOFINA Chemicals, Inc., accessed July 30, 2000, via URL http://www.atofinachemicals. com/whatsnew/index.cfm?DisplayDate=01/01/2000).

*Iran.*—Iran first produced fluorspar in 1960 as a byproduct of lead mining, and the first fluorspar mine was developed in 1968. In 2000, there were reportedly 10 active mines, most of which are small and produce only a few thousand tons per year. The largest by far is the Kamar Mehdi Mine, which produces about 20,000 t/yr and is located 165 kilometers southwest of Tabas in Khorassan Province. All of Iran's production is metallurgical grade, much of which is hand sorted, although mechanical sorting is used at Kamar Mehdi on smaller size material. The USGS estimated Iran's 2000 production at 20,000 t, but it may be as high as 40,000 to 50,000 t (Hadavi, 2001).

*Mexico.*—DuPont announced plans to sell its 32.88% stake in Mexican HF producer Quimica Fluor S.A. de C.V. to Inmuebles Cantabria S.A. de C.V. Quimica Fluor operates at Matamoros, just across the border from Brownsville, TX. The Quimica Fluor plant has a capacity of 86,000 t/yr and produced about 77,000 t of HF in 1999. DuPont had been a shareholder since 1971, but management no longer believed that maintaining an equity interest in Quimica Fluor was necessary to meet its business needs (Industrial Minerals, 2000a).

The Solvay Group, based in Belgium, acquired Mexican HF producer Norfluor S.A. Norfluor manufactures hydrofluoric acid, ammonium fluoride, and ammonium bifluoride at its plant in Ciudad Juárez. The plant's HF capacity is 31,000 t/yr. To reflect the new ownership of the plant, Norfluor's name was changed to Solvay Fluor México, S.A. de C.V. (Industrial

Minerals, 2000c).

**Russia.**—In late 1999, the Government increased import duties on fluorspar to 15% from 5% to make market conditions more favorable to Russian producers. In 2000, however, the largest domestic producer, Yaroslavsky Mining & Dressing Complex (YMDC), reportedly intended to ask the Russian Government to prohibit tenders on delivering foreign fluorspar to Russia. In lieu of this, YMDC believed that the duties should be raised to 30%. In 2000, YMDC increased its production to about 160,000 t (Industrial Minerals, 2000d).

South Africa.—The Buffalo fluorspar mine in South Africa, which shut down in early 1994, was acquired in May 2000 by International Metals Processing (Pty.) Ltd. (IMP). The company overhauled and recommissioned the flotation plant and associated equipment, a project that was completed by the end of October 2000. The company stated that initially they would be processing feed from high-grade stockpiles and tailings dumps. They planned to recommission the briquet plant to process any material that failed to meet the acid-grade standards. Restarting full-scale mining is not expected until 2003, at which time the mine would have reserves sufficient to maintain mine production for 15 years. Sales in the fourth quarter of 2000 were limited and on a spot basis, but IMP worked on marketing its product directly to consumers worldwide (International Metals Processing (Pty.) Ltd., 2000). The product may be excluded from some acid-grade markets, however, because of high phosphorus levels.

When the Buffalo fluorspar mine was closed by General Mining Union Corp. (GENCOR) in 1994, the company gave as the reasons lower world demand and a drop in prices. In GENCOR's opinion these made the mine unprofitable. This was when Chinese acid-grade prices were \$65 to \$70 per ton, f.o.b. China, or about \$95 per ton U.S. Gulf coast. Under these conditions, GENCOR stated they only had 2 years of reserves left. Because the definition of reserves has an economic dimension, fluorspar prices have an effect on reserve estimates. Reserves as measured at a delivered price of \$95 per ton would be lower than those measured at \$120 per ton.

Vergenoeg Mining Co. (Pty.) Ltd. got approval for its environmental management plan (EMP) from the Department of Minerals and Energy. The EMP considered premining land use, the effect on the environment during mining, the anticipated postmining land use, and the socioeconomic effect of the employment of the local population. After the acquisition of the mine in 1999, partners Metorex (Pty.) Ltd. and Minerales y Productos Derivados S.A. completed a computer model of the ore body; evaluated the existing plant configuration, available equipment, and processing methods; and decided to proceed with long-term capital investment to improve quality and recovery at the mine (Cooke, 2001).

#### **Current Research and Technology**

Representatives of Italian fluorochemicals producer Fluorsid S.p.A. and Swedish process equipment manufacturer Svedala Ltd. presented a paper entitled "Recovery of Fluosilicic Acid and Fluoride Bearing Waters for the Production of a Mixture of Silica and Precipitated Calcium Fluoride Usable for the Production of Cement" at the International Fertilizer Industry Association's 2000 Technical Conference in New Orleans. The process, which has been used by Fluorsid for 9 years, involves the treatment of process waters containing HF,  $H_2SiF_6$ , HCl, and  $H_2SO_4$  via water treatment and filtration. The process waters

are initially treated with limestone and then with hydrated lime (calcium hydroxide). A flocculating agent is added, the slurry is clarified, and then sent to a thickener to bring it up to the optimum concentration for filtration (280 to 300 grams per liter). The slurry is pumped into Svedala tube presses, which, under 100-bar pressures, filter out the solids that are discharged in hard, compact flakes 1 to 3 centimeters thick. The product has a composition of CaF<sub>2</sub> (50% to 65%), SiO<sub>2</sub> (9% to 10%), CaSO<sub>4</sub> (8% to 10%), CaCO<sub>3</sub> (3% to 6%), Al<sub>2</sub>O<sub>3</sub> (2% to 3%), Fe<sub>2</sub>O<sub>3</sub> (1% to 2%), and MgCO<sub>3</sub> (1% to 2%). This product has been found suitable for use in cement manufacturing where a small amount of low-grade fluorspar is added as a flux to reduce the residence time of raw materials in the kiln and thus increase production capacity.

This process was tested to determine its applicability for use in processing fluorosilicic acid from phosphoric acidplants. The tests returned results of CaF<sub>2</sub> (70%), SiO<sub>2</sub> (17%), CaCO<sub>3</sub> (6%), Al<sub>2</sub>O<sub>3</sub> (1%), and Fe<sub>2</sub>O<sub>3</sub> (1%). Although still suitable for the cement market, the high SiO<sub>2</sub> content would likely make it unsuitable for the metallurgical market. Fluorsid believes that the process could be successfully applied to fluorinated muds produced from the processing of phosphate rock (Lavanga and others, 2000).

#### Outlook

Fluorocarbon production from HF is the single largest market that drives fluorspar demand. Demand for HFC 134 is benefiting from steady auto sales, retrofits, and an emerging aftermarket. In the United States, HFCs and HCFCs used as refrigerants in large cooling chillers are in demand as the conversion from CFC chillers to non-CFC chillers continues. Chillers cool water that is circulated through buildings to air condition factories, hospitals, malls, offices, etc. By the end of 2001, it was expected that about one-half of the 80,000 CFC chillers in operation in the early 1990s would have been converted. The rate of conversion will likely be accelerated because of high electricity prices (new chillers can be 40% more efficient than the units being replaced) and a shrinking supply of CFCs 11 and 12. As an indication of the expected increase in demand, companies have completed or announced capacity increases for HFCs 32, 125, 134a, 227ea, and 245fa in France, Germany, Japan, the United Kingdom, and the United States. There is, however, much uncertainly related to market losses to not-in-kind replacements, tighter recycling requirements in airconditioning systems that will reduce aftermarket sales, the ban on the foam-blowing agent HCFC 141b in 2003, and potential future restrictions owing to the global warming potential of fluorocarbons. The fluoropolymer and fluoroelastomer markets are growing at an even faster rate, and fluorine compounds such as chlorine trifluoride, nitrogen trifluoride, and tungsten hexafluoride used by the semiconductor industry are in increased demand.

In recent years, the aluminum industry has experienced a 3.3% annual decrease in the consumption of AlF<sub>3</sub>. This was the result of better filtering of alumina hydrate to remove Na<sub>2</sub>O, an impurity the addition of AlF<sub>3</sub> addresses, and because the new smelters introduced had much lower AlF<sub>3</sub> consumption rates. This trend is expected to reverse itself, especially since the largest increases in aluminum production are expected to be in China and the Commonwealth of Independent States (C.I.S.), which will continue using older smelters. Considering only that portion of AlF<sub>3</sub> demand supplied by fluorspar, based on

estimates of relative aluminum production growth for China, C.I.S, and the West, the demand for fluorspar in this market may increase by as much as 15,000 to 17,000 t/yr through 2004. The largest portion of this increase is expected to occur in China and the C.I.S. In the longer term, new smelting technologies could lower fluorspar demand significantly. Widespread adoption of the new Kvaerner Process Technology fluorosilicic acid/HF process, which can be used to manufacture AlF<sub>3</sub> as a byproduct of phosphoric acid production, could conceivably replace the production of AlF<sub>3</sub> from fluorspar (Reynolds, 2001).

The domestic steel industry is plagued by high levels of imports, large inventories, and bankruptcies; the slowing economy will only exacerbate the industry's problems. Through the middle of June 2001, domestic steel production was 13% lower than that in the same period in 2000. These factors are expected to cause an estimated 10% decrease in U.S. steel production in 2001, and fluorspar sales for steel are likely to decrease by a similar amount. The economic slowdown will have a similar effect, although probably not as large, on other small merchant markets. In the long term, growth is still expected in the cement market. Some cement manufacturers are starting to use fluorspar in clinker production. Fluorspar can be added to limestone in the cement kiln as a fluxing agent, where it reduces the residence time and increases production capacity.

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	TABLE	1	
SALIENT	FLUORSPAR	STATISTICS	1/2/

		1996	1997	1998	1999	2000
United States:						
Production						
Finished (shipments) e/	metric tons	8,200				
Value, free on board mine	thousand dollars	W				
Exports 3/	metric tons	61,600	62,100	23,600	55,400	39,800
Value 4/	thousands	\$8,110	\$8,330	\$3,890	\$6,970	\$5,330
Imports: 3/	metric tons	513,000	538,000	503,000	478,000	523,000
Value 5/	thousands	\$71,000	\$69,500	\$62,700	\$56,900	\$65,200
Value per ton, acid grade 5/		\$142.00	\$134.00	\$128.00	\$124.00	\$128.00
Value per ton, metallurgical	grade 5/	\$103.00	\$90.70	\$89.20	\$87.80	\$84.30
Consumption:						
Reported	metric tons	527,000	491,000	538,000	515,000	512,000
Apparent 6/	do.	719,000	551,000	591,000	615,000	601,000
Stocks, December 31:						
Consumer and distributor 7/	do.	234,000	375,000	468,000	373,000	289,000
Government stockpile	do.	667,000	448,000	243,000	146,000	112,000
World, production	do.	4,040,000 r/	4,170,000 r/	4,370,000 r/	4,420,000 r/	4,520,000 e/
	11 117 1111	•		7		, ,

e/ Estimated. r/ Revised. W Withheld to avoid disclosing company proprietary data. -- Zero.

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

2/ Does not include fluorosilicic acid (H2SiF6) or imports of hydrofluoric acid (HF) and cryolite.

3/ Source: U.S. Census Bureau, adjusted by the U.S. Geological Survey.

4/ Free alongside ship values at U.S. ports.

5/ Cost, insurance, freign values at U.S. ports.

6/ U.S. primary and secondary production plus imports minus exports plus adjustments for Government and industry stock changes. 7/ Includes fluorspar purchased from the national defense stockpile, but still located at national defense stockpile depots.

#### TABLE 2

#### U.S. REPORTED CONSUMPTION OF FLUORSPAR, BY END USE 1/

#### (Metric tons)

	Containing more th	an 97% CaF2	Containing not more th	han 97% CaF2	Tot	al
End use or product	1999	2000	1999	2000	1999	2000
Hydrofluoric acid and aluminum fluoride	469,000	474,000	1,220	16	470,000	474,000
Basic oxygen furnaces			9,590	8,600	9,590	8,600
Electric furnaces	W	W	8,780	7,270	8,780	7,270
Other 2/	14,300	13,600	11,600	8,650	25,900	22,200
Total	483,000	487,000	31,200	24,500	515,000	512,000
Stocks (consumer), December 31	65,400	48,300	25,200	25,700	90,500	73,900

W Withheld to avoid disclosing company proprietary data. -- Zero.

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

2/ Includes enamel, glass and fiberglass, iron and steel foundries, primary aluminum, primary magnesium, and welding rod coatings.

# TABLE 3PRICES OF IMPORTED FLUORSPAR

#### (Dollars per metric ton)

Source-grade	1999	2000
Mexican:		
Free on board (f.o.b.) Tampico:	-	
Acidspar filtercake	110-130	110-130
Metallurgical grade	85-105	85-105
F.o.b. Mexico, acidspar filtercake, As <5 ppm	130-140	132-145
South African, acidspar dry basis, f.o.b. Durban	105-125	105-125
U.S. Gulf port, dry basis, acidspar	127-138	130-135

Sources: Industrial Minerals, no. 387, p. 70, December 1999, and no. 399, p. 74, December 2000.

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

	199	1999		00
	Quantity		Quantity	
Country	(metric tons)	Value 2/	(metric tons)	Value 2/
Canada	24,400	\$3,900,000	18,100	\$2,930,000
Dominican Republic	104	18,900	62	9,090
Italy	27,800	2,540,000	13,200	1,210,000
Korea, Republic of	3	3,120		
Mexico	136	40,800	4,520	441,000
Taiwan	1,990	278,000	3,310	592,000
United Kingdom	62	11,900		
Other 3/	845	178,000	647	146,000
Total	55,400	6,970,000	39,800	5,330,000

-- 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.

3/ Includes Australia, Belgium, France, Germany, India, Ireland, Japan, the Netherlands, Papua New Guinea, Saudi Arabia, Spain, Sweden, Switzerland, and Venezuela.

Source: U.S. Census Bureau, adjusted by the U.S. Geological Survey.

#### TABLE 5

#### U.S. IMPORTS FOR CONSUMPTION OF FLUORSPAR, BY COUNTRY AND CUSTOMS DISTRICT 1/

	19	99	20	00
	Quantity	Value 2/	Quantity	Value 2/
Country and customs district	(metric tons)	(thousands)	(metric tons)	(thousands)
Containing more than 97% calcium fluoride (CaF2)				
Austria, Charleston	107	\$63		
China:				
Houston	179,000	22,400	183,000	\$23,200
New Orleans	108,000	13,400	145,000	19,800
Total	287,000	35,900	328,000	43,000
France, Philadelphia	163	67	204	80
Germany:				
Boston			112	14
Philadelphia			172	20
Savannah	291	53	68	37
Total	291	53	352	71
Kenya, Laredo			18	3
Mexico:				
Detroit	204	38	71	12
El Paso	1	3		
Laredo	17,300	2,130	17,700	2,350
New Orleans			3,900	378
Total	17,500	2,170	21,700	2,740
South Africa:				
Houston	23,700	2,890	42,600	5,020
New Orleans	90,000	10,600	91,200	11,000
Total	114,000	13,500	134,000	16,000
United Kingdom:				
New York City	13	21	15	28
Los Angeles	95	13	182	23
Total	108	33	197	51
Grand total	419,000	51,800	484,000	62,000
Containing not more than 97% CaF2				
Canada, Buffalo	97	29	21	6
China:				
New Orleans	16,700	1,500		
Ogdensburg	9	4		
Total	16,700	1,500		

See footnotes at end of table.

# TABLE 5--Continued U.S. IMPORTS FOR CONSUMPTION OF FLUORSPAR, BY COUNTRY AND CUSTOMS DISTRICT 1/

	19	1999		2000	
	Quantity	Value 2/	Quantity	Value 2/	
Country and customs district	(metric tons)	(thousands)	(metric tons)	(thousands)	
Containing not more than 97% CaF2Continued:					
Mexico:					
Laredo	4,400	\$374	2,430	\$201	
New Orleans	37,500	3,250	36,300	3,040	
Total	41,900	3,620	38,700	3,240	
United Kingdom, Philadelphia			6	17	
Grand total	58,700	5,150	38,700	3,260	
Total imports all grades	478,000	56,900	523,000	65,200	

-- 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, adjusted by the U.S. Geological Survey.

#### TABLE 6

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

	19	99	2000		
	Quantity	Value 2/	Quantity	Value 2/	
Country	(metric tons)	(thousands)	(metric tons)	(thousands)	
Canada	26,800	\$31,000	36,000	\$41,100	
China	17	14	144	99	
France	343	374	212	209	
Germany	147	349	150	285	
Japan	1,440	4,150	1,670	4,590	
Korea, Republic of			80	329	
Mexico	91,200	83,700	92,400	84,500	
United Kingdom	38	40	163	189	
Total	120,000	120,000	131,000	131,000	

-- 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 7
U.S. IMPORTS FOR CONSUMPTION OF CRYOLITE, BY COUNTRY 1/

	19	99	20	00
	Quantity	Value 2/	Quantity	Value 2/
Country	(metric tons)	(thousands)	(metric tons)	(thousands)
Australia	2,490	\$1,410	2,140	\$1,220
Canada	1,960	527	2,840	1,090
China	442	356	398	323
Denmark	222	355	76	119
Germany	2,700	2,810	2,770	2,840
Hungary	391	428	439	495
Japan	17	16	20	19
New Zealand	557	405		
Spain	323	281		
United Kingdom	294	419	333	486
Other 3/	172	143	174	131
Total	9,560	7,160	9,190	6,730

-- 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 Austria, Belgium, Hong Kong, India, Italy, and Russia.

Source: U.S. Census Bureau.

#### TABLE 8

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

	19	99	20	00
	Quantity	Value 2/	Quantity	Value 2/
Country	(metric tons)	(thousands)	(metric tons)	(thousands)
Canada	5,330	\$4,500	3,610	\$3,080
Italy			2,880	2,000
Mexico	11,100	9,340	11,600	9,550
Norway	2,800	2,620	2,580	2,020
Other 3/	151	248	763	647
Total	19,300	16,700	21,500	17,300

-- Zero.

 $1/\operatorname{Data}$  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 China, Finland, Germany, India, Israel, Japan, and Sweden.

Source: U.S. Census Bureau.

# TABLE 9FLUORSPAR: WORLD PRODUCTION, BY COUNTRY 1/2/

(Metric tons)

Country and grade 3/4/	1996	1997	1998	1999	2000 e/
Argentina	5,666	7,168	7,200 e/	7,000 e/	7,000
Brazil (marketable):					
Acid grade	46,706	66,859	61,024	61,000 e/	61,000
Metallurgical grade	12,334	11,174	11,058	11,000 e/	11,000
Total	59,040	78,033	72,082	72,000 e/	72,000
China: e/					
Acid grade	1,250,000	1,150,000	1,180,000	1,200,000	1,250,000
Metallurgical grade 5/	900,000	1,150,000	1,170,000	1,200,000	1,200,000
Total	2,150,000	2,300,000	2,350,000	2,400,000	2,450,000
Egypt e/	700	775 r/	140 r/	500 r/	500
France: e/					
Acid and ceramic grades	78,000 6/	80,000	80,000	82,000	80,000
Metallurgical grade	33,000 6/	30,000	30,000	25,000	20,000
Total	111,000 6/	110,000	110,000	107,000	100,000
Germany e/	32,448 6/	24,000	25,000	28,000	30,000
India:					
Acid grade	5,115	6,937	e/	e/	6/
Metallurgical grade	14,263	9,877	785 6/	800 e/	850 6/
Total	19,378	16,814	785 6/	800 e/	850 6/
Iran 7/	20,000	20,000 e/	25,904 r/	18,387 r/	20,000
Italy: e/		,	,	,	,
Acid grade	103,527 6/	106,000	92,000	95,000	50,000
Metallurgical grade	23,000 6/	20,000	15,000	15,000	15,000
Total	126,527 6/	126,000	107,000	110,000	65,000
Kenya, acid grade	83,000	68,700	60,854	98,000 e/	90,000
Korea, North, metallurgical grade e/	39,000	39,000	30,000	25,000	25,000
Korea, Republic of, metallurgical grade e/	´	617 6/			·
Kyrgyzstan	2,767	4,176	3,200 e/	2,997	3,000
Mexico: 8/		,			*
Acid grade	279,033	290,580	330,711	324,741 r/	350,000
Metallurgical grade	244,938	262,260	267,331	236,524 r/	285,000
Total	523,971	552,840	598,042	561,265 r/	635,000
Mongolia:					
Acid grade	130,000	130,000	122,000	100,000 r/	111,443 6/
Other grades 9/	37,000	41,000	45,900 r/	54,600 r/	87,400 6/
Total	167,000	171,000	167,900 r/	154,600 r/	198,843 6/
Morocco, acid grade	95,900	103,800	110,000 e/	110,000 e/	100,000
Namibia, acid grade 10/	32,285	23,208	40,685	57,700 r/	58,000
Pakistan, metallurgical grade		1,050	1,000 e/	220	700
Romania, metallurgical grade e/	15,000	15,000	15,000	15,000	15,000
Russia e/	40,000 r/	8,000 r/	120,000 r/	155,000 r/	160,000

See footnotes at end of table.

## TABLE 9--ContinuedFLUORSPAR:WORLD PRODUCTION, BY COUNTRY 1/2/

#### (Metric tons)

Country and grade 3/4/	1996	1997	1998	1999	2000 e/
South Africa: e/ 11/					
Acid grade	191,018 6/	201,000	222,000	203,280 r/6/	197,855 6/
Ceramic grade	6/	4,000			
Metallurgical grade	12,000	2,000	15,000	14,000	14,500
Total	203,018 6/	207,000 6/	237,000 6/	217,280 6/	212,355 6/
Spain: e/					
Acid grade	109,085 6/	110,000	110,000	123,000	115,000
Metallurgical grade	7,441 6/	10,000	10,000	10,000	10,000
Total	116,526 6/	120,000	120,000	133,000	125,000
Tajikistan e/	9,000	9,000	9,000	9,000	9,000
Thailand, metallurgical grade	17,247	7,826	3,743	13,005 r/	4,745 6/
Tunisia	720	1,426	1,196	520	6/
Turkey, metallurgical grade e/	4,828 6/	5,000	5,000	5,000	5,000
United Kingdom e/	65,000	64,000	65,000	42,000	45,000
United States (shipments) e/	8,200				
Uzbekistan e/	90,000	90,000	80,000	80,000	80,000
Grand total	4,040,000 r/	4,170,000 r/	4,370,000 r/	4,420,000 r/	4,520,000

e/ Estimated. r/ Revised. -- Zero.

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

2/ Table includes data available through June 1, 2001.

3/ In addition to the countries listed, Bulgaria is believed 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/ Reported figure.

7/ Year beginning March 21 of that stated.

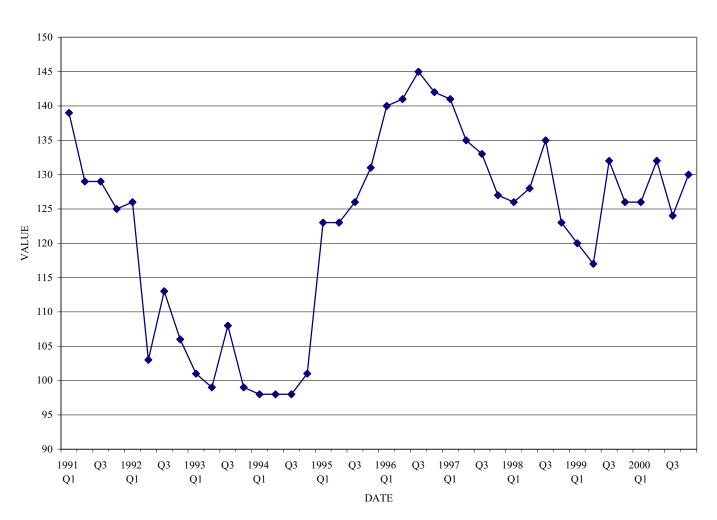
8/ Data are reported by Consejo de Recursos Minerales, but the production of submetallurgical and acid grades has been redistributed or the basis of industry data.

9/ Principally submetallurgical-grade material.

10/ Data are in wet tons.

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

#### FIGURE 1 ACID-GRADE FLUORSPAR IMPORT PRICES BY QUARTER



(Dollars per metric ton, c.i.f. port of entry, Q=quarter)