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BARITE [ADVANCE RELEASE]

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Barite

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In 2021, primary U.S. barite production (sold or used by producers) decreased, but quantity and value data were withheld to avoid disclosing company proprietary information. Ground barite sold or used by processors, a reasonable indication of consumption, was 1.67 million metric tons (Mt), an increase of 19% compared with 1.41 Mt in 2020. General imports were 1.44 Mt and exports were 61,600 metric tons (t). World barite production was 6.73 Mt, an increase of 16% compared with 5.79 Mt (revised) in 2020 (tables 1, 3, 5, 6).

Barite's primary use was as a weighting agent in oil- and gas-drilling fluids, and so trends in sales of ground barite generally mirrored trends in drilling rig counts (fig. 1). This use typically accounted for more than 90% of domestic consumption and approximately 70% of global consumption (Barytes Association, The, undated). In 2020, global oil consumption was affected adversely by travel restrictions owing to the global coronavirus disease 2019 (COVID-19) pandemic and reduced demand for transport fuels (World Bank Group, 2020, p. 19). In late 2020 and throughout 2021, easing of pandemic-related travel restrictions resulted in global oil consumption increasing by 5.5% in 2021 from that in 2020, but remained 3% below 2019 levels (U.S. Energy Information Administration, 2022, p. 3). Similarly, the worldwide average rig count increased to 1,361 from 1,351 in 2020. Rig count increases in 2021 were limited to North America and South America, but remained well below prepandemic counts in all countries and (or) localities. In the United States, the annual average rig count was 475 in 2021, an increase of 9% compared with 436 in 2020, but still one-half the annual average rig count of 944 in 2019 (Baker Hughes Co., 2022).

Barite is the mineralogical name for barium sulfate ($BaSO_4$). In commerce, the mineral is sometimes referred to as barytes. In this chapter, the term "primary barite" refers to the first marketable product, which includes crude barite that has undergone simple beneficiation methods, such as jigging, tabling, and washing, or more complex methods, such as flotation, heavy-media separation, or magnetic separation. Most barite ores require some upgrading to achieve minimum commercial purity or density levels.

Production

Domestic production and sales data for barite were derived from voluntary responses to a U.S. Geological Survey (USGS) canvass. Responses were received from four mining operations, which constituted 100% of domestically mined barite sold or used at company grinding mills. All of the mines were in Nevada. Data were received from 16 of the 23 grinding mills that operated during the year, representing 64% of the quantity of ground barite sold. Estimates for nonrespondents were made using prior year and other industry data.

In 2021, most of the leading companies that mined and ground barite in the United States were also major oil-service companies. Information on active U.S. barite mines and grinding mills can be found in table 2. Crude barite production decreased in 2021 compared with that in 2020, but quantity and value data were withheld to avoid disclosing company proprietary information.

The only facilities that were active in Nevada for all of 2021 were M-I L.L.C.'s (operating as MI-SWACO) Greystone and Mountain Springs Mines and Battle Mountain grinding plant. Although domestic mine production increased between 2016 and 2019, it never returned to levels achieved prior to an industry downturn in 2015 brought on by a decrease in oil price. Since that time, several Nevada barite operations have been idled. Halliburton Energy Services, Inc.'s Rossi Mine had been in continuous operation since 1947 until it was idled in 2015. However, since that time, the company continued to work on increasing mine life through an expansion, and in December 2021 the mine resumed production. Progressive Contracting Inc.'s Coyote Mine and Baker Hughes Inc.'s Nevada assets including the Slaven Canyon Mine and the Argenta Mine and mill were all idle in 2020 and 2021 (table 2).

Twenty-three grinding mills operated for all or part of 2021. Most Nevada barite ore was ground at nearby company-owned grinding mills. In addition to the 4 grinding mills in Nevada, 13 grinding mills operated along the coast of the Gulf of Mexico (5 in Louisiana and 8 in Texas). These stand-alone grinding mills processed imported crude barite that was ground primarily to American Petroleum Institute (API) specifications for the oil- and gas-drilling market, although some was ground for other uses. An additional six grinding mills in California, the Midwest, and the Southeast ground barite for use as extenders, fillers, pigments, and other uses and produced API-grade barite for the oil- and gas-drilling market.

In 2021, CIMBAR Performance Minerals, Inc. finalized the purchase of two grinding plants in Corpus Christi, TX. The first plant, formerly owned by TOR Minerals International, Inc., processed barite for the paint industry. The second plant, formerly owned by Baker Hughes Inc., processed barite for oil and gas drilling (CIMBAR Performance Minerals, Inc., 2021; TOR Mineral International, Inc., 2021).

In September, the Governor of West Virginia announced that CS Global Group (Turkey) would invest $10 million to construct a barite grinding plant in Moundsville, WV, which initially would produce barite for the oil- and gas-drilling industry. Later stages of the project would add capability to produce micronized barite for the automotive and paint industries. The plant, which would be incorporated as ADO Industries Inc., was expected to begin operation in early 2022 (Office of the Governor [West Virginia], 2021).

Consumption

In 2021, domestic apparent consumption of barite increased, but data were withheld to avoid disclosing company proprietary information (table 1). Total sales of ground barite (sold or used by processors) in all regions were 1.67 Mt, an increase of 19% compared with 1.41 Mt in 2020. Sales in Louisiana decreased by 6% to 483,000 t, those in Texas increased by 31% to 652,000 t, and sales by mills in all other States combined increased by 37% to 538,000 t (table 3). Nearly 90% of the barite sales from domestic crushers and grinders were for oil- and gas-drilling markets, and the remaining sales were for other industrial end uses.

Drilling fluids, also known as muds, perform a number of functions in well drilling including controlling formation pressure, cooling and lubricating the drill bit, maintaining wellbore stability, removing formation cuttings, and transmitting hydraulic energy to the bit. Drilling fluids typically are made up of liquid and solid phases (Williamson, 2013). The primary role of barite in drilling fluids was as a solid state weighting agent. Barite is a component of almost all drilling fluids, accounting for approximately 10% of the composition of lightweight, oil-based muds and up to more than 40% (by weight) of heavyweight, oil-based muds (Bosch, 2016, p. 10). As a well is drilled, the drill bit passes through various formations, each with different characteristics. To maintain formation pressure, deeper wells require more heavily weighted muds, and therefore a higher percentage of barite or an alternative higher specific gravity (SG) weighting agent in the mud mix. Barite is ground to a small, uniform size, based on specifications set by the API, before use as a weighting agent in drilling mud.

The most essential characteristic of barite used in drilling fluid is its SG. Until 2010, the API specifications called for weighting agents with a minimum SG of 4.20. Because of concerns about dwindling reserves of 4.20-SG barite, the API issued a new edition of "API Specification 13A, Specification for Drilling Fluids Materials," which added specifications for 4.10-SG weighting agents (effective August 1, 2010). Except for SG, specifications for 4.10-SG weighting agents are the same as those for 4.20-SG weighting agents. These specifications require weighting agents to be ground finely enough that at least 97% of the material (by weight) passes through a 200-mesh (Tyler) [75-micrometer (µm)] screen and no more than 30% (by weight) can be less than 6 µm in effective diameter. The diameter is measured using sedimentation techniques. Lastly, weighting agents may contain a maximum of no more than 250 parts per million (ppm) of water-soluble alkaline earth metals, such as calcium (American Petroleum Institute, 2010, p. 13–23, 83–96).

Since the adoption of the 4.10-SG specifications, 4.10-SG and sub-4.10-SG barite have gained widespread acceptance in the U.S. drilling industry. Increasingly considered "premium" material, 4.20-SG barite is combined with lower SG barite to create blends tailored for specific applications (Newcaster, 2015). Within the barite industry, the term "grade" usually refers to barite of differing SGs, as opposed to indicating purity, as is the case with many other mineral commodities. Although higher SG barite typically contains a higher percentage of barite, the presence of certain impurities also can raise the SG of lower purity material.

Since the adoption of the 4.10-SG specifications, two other trends in non-API-conforming barite have emerged—the use of sub-4.10-SG barite and the use of barite with a finer particle size. Because neither the USGS barite canvass nor the Harmonized Tariff Schedule of the United States (HTS), used to categorize trade data, differentiate between barite products of differing SGs, little information is available about the relative proportion of the differing SGs of barite used. However, The Barytes Association estimated that in recent years 60% of barite sales in the United States were 4.10 SG, 30% did not meet the API specifications for SG, and 10% were 4.20 SG (Barytes Association, The, 2019, p. 8).

Although the 4.10-SG specifications were proposed initially as a way to extend domestic barite resources, a subsequent study challenged that assertion because the use of lower SG weighting materials affects fluid performance in a way that may ultimately require the use of more drilling fluid. This effect is less problematic for lower density fluids but is exacerbated as fluid density increases. As fluid circulates through the drilling system, it becomes contaminated with cuttings from the formation, contributing low-gravity solids which reduce fluid efficacy and decrease longevity. Because lower SG barite usually contains more impurities (typically quartz and other materials with a lower SG than barite), the impurities contribute to total low-gravity solids and inhibit the fluid's ability to incorporate drill solids (Scott and Robinson, 2010; Miller, 2017, p. 10, 11). These were likely some of the reasons that the API was reportedly not considering additional specifications for weighting materials with an SG of less than 4.10 (O'Driscoll, 2019).

Some barite processors also have concluded that the financial benefit of using lower cost and lower quality barite was more than offset by increased processing costs. Because lower quality barite typically contained higher levels of more abrasive impurities such as iron oxides and quartz, it contributed to increased wear on equipment and reduced productivity (Carrasale, 2021).

The color of barite used for drilling petroleum varies and can be black, blue, brown, buff, or gray. In addition to a high SG, other advantageous properties of barite include low abrasion, chemical and physical inertness, low oil absorption, low solubility, nontoxicity, and a relatively low cost when compared to alternatives. An additional benefit of barite is that it does not interfere with magnetic measurements taken in the borehole, either during logging-while-drilling or in subsequent drill-hole logging. The most common weighting material alternatives included calcium carbonate, hematite, ilmenite, and manganese tetroxide, but were often more expensive and consequently reserved for specific applications (Offenbacher and others, 2023, p. 2). For all of these reasons, barite has been the leading choice for use as a weighting agent in oil and gas drilling, and available substitutes have not significantly displaced barite in this application.

Industrial end uses, such as barium chemicals, filler in paint and plastics, and powder coatings, required barite be ground to a small, uniform size. The required size depended on the application, but for paint- and plastic-grade material, grain size was approximately 2 to 3 µm. Barite-containing materials were used for sound reduction in engine compartments in

automobiles, boats, and trucks. Barite also was used in the base coat of automobile finishes for smoothness and corrosion resistance and continued to be used in friction products for automobiles and trucks.

Barite used as an aggregate in "heavy" concrete or radiation-shielding concrete was crushed and screened to sizes ranging from 4.75 millimeters (0.187 inches) to 3.75 centimeters (1.5 inches).

Prices

Because domestic barite-mining companies sold very little crude barite, value data for crude barite were largely estimated. The average unit value for crude barite from domestic mines and their associated beneficiation plants was withheld to avoid disclosing company proprietary information (table 1).

Value data for ground barite, as reported to the USGS, do not necessarily represent open market prices. Because oil-service companies owned many of the U.S. barite grinding mills, barite often was sold to customers at a reduced price or at cost because the barite was merely a small part of the overall service contract. Taking this reduced cost into account when comparing prices with those in 2020, the average unit value for barite ground in Louisiana increased by almost $2 to $132 per metric ton; the average unit value for barite ground in Texas decreased by almost $4 to $162 per metric ton; and the unit value of barite ground in other States decreased by almost $68 to $205 per metric ton (table 3). The unit value of sales for barite used in chemicals, glass, paint, rubber, and other filler decreased by $57 per metric ton to $471 per ton in 2021. The average unit value for drilling-grade barite decreased by $11 per metric ton to $133 per metric ton.

According to published prices for API-grade 4.20-SG unground lump barite from major exporting countries, the 2021 annual average free on board (f.o.b.) price for barite from China was $100 per metric ton compared with $97 per metric ton in 2020. The f.o.b. import price for barite from Chennai, India, was $93 per metric ton compared with $91 per metric ton in 2020. The f.o.b. import price for barite from Morocco was $92 per metric ton compared with $89 per metric ton in 2020 (Fastmarkets, 2023). Price increases likely were influenced by the conclusion of Andhra Pradesh Mineral Development Corp. Ltd.'s (APMDC's) (India) biennial tender in the first quarter of 2021. Barite prices from India have mostly replaced barite prices from China as an informal global price benchmark owing to decreased availability of Chinese barite for the export market. The 2021 APMDC tender resulted in an increase of up to $3 per metric ton, depending on grade (Newcaster, 2021, p. 8).

Transportation

Because of the higher cost of rail and truck transportation compared to ocean freight, the majority of crude barite mined in Nevada was ground in Nevada and then sold to companies drilling in the Central and Western United States, whereas offshore drilling operations in the Gulf of Mexico and onshore drilling operations in regions other than the Central and Western United States primarily used imported barite. The proximity of drilling operations in the Permian Basin to mines in northern Mexico also has contributed to increased imports by truck in recent years (Barytes Association, The, 2019, p. 6). Industry analysts have observed that decreased demand, higher land-based transportation costs, and availability of lower priced imports have contributed to historically low barite mine production compared with pre-2015 levels (Newcaster, 2022, p. 23, 24).

Since 2014, annual U.S. net import reliance for barite has exceeded 75% (McRae, 2018, 2023). Most crude barite imports were shipped in handymax-size bulk carriers (typically 35,000- to 60,000-t deadweight tonnage). After being ground to API specifications, barite was transferred from grinding mills to onshore or offshore drilling platforms using some combination of barges, rail, or trucks. Imported ground barite shipped via ocean freight typically was shipped in containers.

As a bulk commodity used primarily for its weight, transportation expenses are a substantial component of the final cost of barite used on a per ton basis, accounting for approximately 30% of final cost. To maximize shipping cost efficiency for the dry-bulk ocean leg of the journey, shipment sizes have increased over time to 60,000 t in recent years. Although this practice reduces cost per ton, it also can be an impediment to smaller barite suppliers being able to enter the market, as they may not be able to supply barite in larger quantities. Barite market participants also minimize shipping costs by coordinating barite shipments with ships that transport other commodities. For example, historically, ships that transported soybeans from the United States to China were frequently used to transport barite back to the United States (Offenbacher and others, 2023, p. 1, 3).

In 2021, increased diesel and bunker fuel prices contributed to increased transportation costs for all transportation modes including dry-bulk and container ocean freight, rail, and truck freight. Ocean freight also was adversely affected by limited ship availability and port congestion. Because daily rates for containers increased faster than the increase in dry-bulk prices, some cargo that was normally shipped in containers shifted to the dry-bulk market even though dry-bulk cargo volume exceeded available capacity. The container shortage was particularly problematic for powdered barite trade; for example, oilfields in western Canada often imported powdered barite from India and Turkey (Newcaster, 2021, p. 11, 13; 2022, p. 30; Dodd, 2022, p. 19; Viking Shipping Co. AS, 2022, p. 4, 5, 8, 9).

Foreign Trade

The U.S. Census Bureau provides two different measures for imports—general imports and imports for consumption. General imports measure merchandise that enters the United States regardless of whether it immediately enters consumption channels, bonded warehouses, or foreign trade zones (FTZs). Imports for consumption, however, are recorded only for merchandise that enters consumption channels. Therefore, merchandise that enters bonded warehouses and FTZs is not recorded until it is withdrawn. The normal duty rate on U.S. imports of crude barite [Harmonized Tariff Schedule of the United States (HTS) code 2511.10.5000)] was $1.25 per metric ton, but imports of ground barite (HTS code 2511.10.1000) were free from duty. Imports for consumption classify imported crude barite that was subsequently ground in an FTZ as ground,

thereby avoiding the tariff. As a result, the major importers of crude barite applied for and received FTZ status for many of their grinding mills in the United States. Imports for consumption data tend to be very similar to USGS reported sales of ground barite sold or used by processors. Conversely, general imports recorded crude barite received from foreign suppliers as crude barite regardless of where it entered the United States. The 10 grinding mills that were located in FTZs are identified in table 2.

Because of the carrying cost of stocking barite, barite processors try to minimize inventory. Consequently, in most years, there has been little difference in the quantity of barite reported by general imports and imports for consumption. However, sudden changes in oil- and gas-drilling can cause the two metrics to decouple. For example, in 2020, COVID-19 pandemic-related travel restrictions quickly and dramatically reduced global demand for oil, which in turn affected drilling activity and barite consumption. In 2020, imports for consumption were 1.48 Mt, 71% more than general imports, which were 869,000 t. The difference is attributed to two primary factors. First, because drilling rigs operate under contract, drilling typically continues until those contracts expire. Second, because it can take as much as 2 to 3 months for barite mining companies to accumulate and load a shipload of barite, and an additional 6 months for barite to be ground and delivered to customers, much of the barite used in 2020 would already have been in transit at the time the travel restrictions were imposed. This rationale is supported by the difference between the two measures from the first half of the year to the second half of the year. In the first 6 months of 2020, imports for consumption were 41% more than general imports. By the second half of the year, imports for consumption were more than double general imports, suggesting that processors may have been working off existing inventory. In 2021, imports for consumption only exceeded general imports by 15%.

In 2021, barite exports (natural barium sulfate and other sulfates of barium, the chemically precipitated form of barite) were 61,600 t, a 29% increase compared with that in 2020. The leading recipients of barite exports from the United States were Canada (65%), Mexico (24%), and Guyana (8%) (table 5).

The United States historically has been the world's leading barite importer. In 2021, general imports of barite (crude and ground natural barium sulfate, and precipitated barium sulfate) totaled 1.44 Mt, an increase of 65% compared with those in 2020 (tables 1, 6). This was more than triple that of Saudi Arabia, the world's second-leading importer (Zen Innovations AG, 2023). Morocco supplied 30% of domestic general imports, surpassing both India (28%) and China (23%) to become the leading source of domestic general imports in 2021. Mexico supplied an additional 16% of domestic general imports. Morocco's emergence as the leading source of domestic general imports was reportedly facilitated by Moroccan suppliers' ability to offer smaller shipments and shorter lead times, which allowed domestic consumers increased flexibility in responding to uncertainty in anticipated future consumption levels (Laghzali, 2022, p. 22). General crude barite imports accounted for 87% of all general barite imports, and more than 90% of ground barite general imports were from Mexico. General imports of the several forms of barite reported under the HTS nomenclature "Other sulfates of barium," the chemically precipitated form of barite used primarily in specialty applications, were 15,900 t, a 19% increase compared with those in 2020 (table 6).

Environment

Common impurities in drilling-grade barite include chert, dolomite, quartz, siderite, and metallic oxide and sulfide compounds. These impurities are ordinarily insoluble and, as a result, standards limiting their concentrations have not been developed. In addition, the API standard does not address heavy-metal impurities, but barite derived from base-metal deposits can contain heavy metals, such as cadmium and mercury, and discharges of these are often regulated by environmental laws. For example, U.S. environmental regulations on offshore drilling allow drilling waste discharges containing barite only if the barite contains less than 3 parts per million cadmium and less than 1 ppm mercury (Argonne National Laboratory, ChevronTexaco, and Marathon Oil Company, 2009).

World Review

Estimated world barite production, excluding the United States, was 6.73 Mt in 2021, an increase of 16% compared with 5.79 Mt (revised) in 2020 (table 8). The top three leading barite-producing countries—China, India, and Morocco—were also the world's leading exporters (Zen Innovations AG, 2023). Production in these countries accounted for 71% of world production.

China.—China was the world's leading barite producer. Although mine production in 2021 was estimated to have increased by 24%, to 2.1 Mt, production was 34% less than that in 2017 (table 8). Similarly, China's barite exports decreased by 40% in 2018 to 1.21 Mt compared with 2.02 Mt in 2017 and have remained below that level ever since. These changes are attributed to China's domestic policies, which since 2018 have sought to strengthen environmental protection and consolidate mining operations. These actions reportedly led to the closure of approximately 80% of China's smaller barite mines and have affected the availability of drilling-grade barite for export more than exports of industrial-grade barite used in chemical production, paint, rubber, and other fillers. Prior to these restrictions being implemented, drilling-grade barite typically accounted for approximately 75% of exports and industrial-grade barite accounted for the remaining 25%. Industrial-grade barite exports in 2021, however, were similar to those in 2017, nearly 500,000 t, and accounted for 53% of barite exports. Drilling-grade barite exports decreased by 71% compared with those in 2017, to 430,000 t. Barite consumption in China was estimated to be approximately 1 Mt annually, of which approximately 750,000 t was used in industrial applications and 250,000 t in the drilling industry (Liao, 2022, p. 3–7).

India.—India was the second-leading producer of barite after China. Production in 2021 was estimated to be 1.6 Mt, unchanged compared with that in 2020 (table 8). The Mangampet Mine, owned by APMDC, was the leading barite mine in the world and accounted for approximately 90% of the barite mined in India. APMDC sold its production to exporters and domestic processing plants through a bidding and tendering

process according to the following classification—A grade met or exceeded SG of 4.20 with an average of 4.25 SG per lot; B grade had a minimum SG of 4.10; and C, D, and Waste (W) grades were low-density products with no guarantee of SG, although SG typically averaged more than 3.90. Stockpiles of low-grade material have accumulated over time. As of January 2015 (the last year that the Indian Bureau of Mines collected barite production statistics), low-grade stocks were 4.9 Mt. Numerous private companies have experimented with improved beneficiation techniques and (or) blending low-grade ore with higher-grade ore to produce a marketable product (Indian Bureau of Mines, 2017, p. 3–6; John Newcaster, Principal, IMPACT Minerals LLC, written commun., February 21, 2020).

Laos, Thailand, and Vietnam.—Prior to the COVID-19 pandemic, Laos had started to emerge as a significant new global source of barite for the export market. Production peaked in 2019 at 486,009 t (table 8). As a landlocked country, exports from Laos were shipped through neighboring countries such as China, Thailand, or Vietnam. In 2021, production decreased by 61% from that in 2020 to 37,400 t, primarily because of difficulty exporting material to neighboring countries, particularly Vietnam, owing to COVID-19 pandemic-related border closures (Lao, 2021, p. 10).

Laos, Thailand, and Vietnam all have long histories of barite production. In addition, Thailand and Vietnam each had capacity to grind and process barite for the oil- and gas-drilling industry, of which a few companies reportedly had supply agreements with mines in Laos, particularly in Vientiane Province near Kasi. Because of these relationships and trade logistics, it has been difficult to ascertain where domestic barite imports from these southeast Asian countries originated, although most are thought to originate in Laos.

Lao-China Base Barite Co. Ltd. had three separate licenses to mine barite northwest of Kasi, Vientiane Province. According to the company, it began exporting barite from its first and largest pit, Pha Yai, in 2018. It planned to develop five additional pits, all containing barite of SG of more than 4.30 and low levels of arsenic, cadmium, and mercury. The company reported that, since beginning operation in 2018, it had exported approximately 600,000 t of barite to localities including the Middle East, China, Thailand, and the United States, until suspending operations in 2020 owing to the COVID-19 pandemic. After suspending operations, the company continued to implement projects to increase capacity and range of offered products including construction of a new jig plant, two grinding plants, and two spiral washers. It also executed an exclusive sales agreement and advanced plans to export barite from the Port of Nghi Son in Vietnam. The company expected that implementation of Laotian railroad projects being developed as part of China's Belt and Road initiative would reduce the company's transportation costs and facilitate access to additional ports in China and Thailand by 2023 (Lao, 2021).

Mexico.—Mexico produced 320,642 t of barite in 2021, a decrease of 14% compared with that in 2020. The leading producing Mexican State continued to be Nuevo Leon, but production also increased in other States such as Chihuahua, Coahuila, and Sonora, which all border the United States. Although the SG of barite in deposits in the States bordering the United States is typically lower than that in deposits in States bordering the Gulf of Mexico, the barite was still suitable for much of the onshore drilling in the Permian Basin of the United States and is in closer proximity to the Permian Basin than the U.S. barite mines in Nevada. Further, because of safety issues owing to lower SG, production from these States bordering the United States is typically not suitable for Mexico's drilling operations which are located offshore in the Gulf of Mexico. For these reasons, more than 90% of Mexico's barite production was estimated to be exported to the United States—primarily by truck, but also by ship and rail—whereas internal consumption in Mexico was supplied primarily by imports and production in States bordering the Gulf of Mexico (Barytes Association, The, 2019, p. 6; Ruiz, 2019, p. 11, 12, 13, 15).

Barimont Minería S. de R.L. de C.V., a joint venture between Baribright International Inc. (Canada) and Chemical Products Corp. (Cartersville, GA) produced 4.1-SG barite from its mining operation in the State of Sonora. In 2021, the company continued construction on a second beneficiation line which was expected to begin operation in 2022. When complete, the operation's total capacity would be 250,000 t/yr of barite ore and 150,000 t/yr of powder (Barimont Minería S. de R.L. de C.V., undated).

Morocco.—Morocco was the third-leading barite-producing country in the world. Production in Morocco was 1.1 Mt in 2021, nearly triple the 410,000 t produced in 2020. The country surpassed China to become the world's second-ranked exporter and surpassed China and India to become the leading supplier of barite to the United States (Zen Innovations AG, 2023). Increased exports were facilitated by ongoing initiatives to expand roads and port facilities to accommodate larger shipments. However, demand for larger shipments increased lead times to prepare larger orders and led to localized supply shortages (Laghzali, 2022, p. 14–16, 22–23). Barite producers in the country included Broychim S.A.R.L., Centrale d'Achat et de Développement de la Région Minière du Tafilalet et de Figuig (CADETAF), Compagnie Marocaine des Barytes S.A. (COMABAR), Société Nord-Africaine de Recherches et d'Exploitation des Mines d'Argana (SNAREMA), and Société Nouvelle Union des Métaux Maroc (SNUMM).

Outlook

Barite's properties, including low abrasiveness, chemical and physical inertness, nontoxicity, low oil absorption, low solubility, and high SG, as well as it being less expensive than alternatives, have made it the leading choice for use as a weighting agent in oil and gas drilling. Available substitutes are not expected to significantly displace barite for the foreseeable future. Long-term barite consumption therefore is expected to be commensurate with trends in oil and gas production and consumption.

Travel restrictions imposed in response to the COVID-19 pandemic contributed to significant decreases in total global oil consumption and production in 2020 compared with consumption and production in 2019. However, the easing of restrictions beginning in 2021 contributed to increasing consumption, particularly after vaccines became widely available in the United States and Europe. Although global oil

consumption in 2021 remained below prepandemic levels in 2019, it began to outpace global oil production, contributing to decreasing oil inventories and increased prices. These factors contributed to increased crude oil production in the United States and by members of the Organization of the Petroleum Exporting Countries in 2021, as well as increased domestic production of dry natural gas and increased domestic exports of liquified natural gas. The U.S. Energy Information Administration expected these trends to continue through at least 2023, which would likely contribute to increased consumption of barite (U.S. Energy Information Administration, 2022, p. 1–3).

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TABLE 1
SALIENT BARITE STATISTICS[1]

(Thousand metric tons and thousand dollars)

	2017	2018	2019	2020	2021
United States:					
Barite, primary:					
Crude, sold or used by producers:					
Quantity	334	366	414	W	W
Value[e]	32,100	40,300	45,700	W	W
Exports:[2]					
Quantity	116	67	38	48	62
Value	29,700	20,100	12,800	14,900	21,200
General imports:[3, 4]					
Quantity	2,360	1,980	2,330	869	1,440
Value	266,000	252,000	292,000	142,000	206,000
Imports for consumption:[3, 5]					
Quantity	2,470	2,460	2,500	1,480	1,660
Value	267,000	284,000	311,000	194,000	215,000
Consumption, apparent[6]	2,680	2,760	2,880	W	W
Crushed and ground, sold or used by processors:[7]					
Quantity	2,030	2,420	2,350	1,410	1,670
Value	364,000	426,000	420,000	257,000	280,000
World, production[8]	8,730 [r]	8,470 [r]	8,530 [r]	5,790 [r]	6,730

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data.
[1]Table includes data available through July 14, 2022. Data are rounded to no more than three significant digits.
[2]Exports include crude, ground, and other barite exports calculated from Schedule B numbers 2511.10.0000 and 2833.27.0000.
[3]Imports include crude, ground, and other barite imports calculated from Harmonized Tariff Schedule of the United States codes 2511.10.1000, 2511.10.5000, and 2833.27.0000.
[4]General import data specify the form of imported barite at the time it enters the United States.
[5]Imports for consumption data specify crude barite processed in free trade zones as ground.
[6]Defined as primary barite sold or used by producers plus imports for consumption minus exports.
[7]From domestically mined and imported crude barite.
[8]May include estimated data.

TABLE 2
BARITE MINES AND GRINDING MILLS IN THE UNITED STATES IN 2021[1]

State and operator (owner)	County or parish	Mine or mill	Foreign trade zone
Mines:			
Nevada:			
Baker Hughes Drilling Fluids (Baker Hughes Inc.)	Lander	Argenta[2]	XX.
Do.	do.	Slaven Canyon[2]	XX.
Halliburton Energy Services, Inc. (Halliburton Co.)	Elko	Rossi[3]	XX.
M-I L.L.C., operating as M-I SWACO (Schlumberger Ltd.)	Lander	Greystone	XX.
Do.	do.	Mountain Springs	XX.
Progressive Contracting Inc.	Elko	Coyote[2]	XX.
Grinding mills:			
California, Industrial Minerals Co.	Sacramento	Florin	XX.
Georgia, CIMBAR Performance Minerals, Inc.	Murray	Chatsworth	XX.
Indiana, CIMBAR Performance Minerals, Inc.	Posey	Mt. Vernon	XX.
Louisiana:			
Baker Hughes Drilling Fluids (Baker Hughes Inc.)	St. Mary	Morgan City	No. 124, Gramercy, LA.
Excalibar Minerals LLC (Newpark Resources, Inc.)	Iberia	New Iberia	Do.
Halliburton Energy Services, Inc. (Halliburton Co.)	Calcasieu	Lake Charles	No. 087, Lake Charles, LA.
Do.	Lafourche	Larose	No. 124, Gramercy, LA.
M-I L.L.C., operating as M-I SWACO (Schlumberger Ltd.)	St. Mary	Amelia	Do.
Nevada:			
Baker Hughes Drilling Fluids (Baker Hughes Inc.)	Lander	Barite Grinding Plant[2]	XX.
Halliburton Energy Services, Inc. (Halliburton Co.)	Eureka	Dunphy[3]	XX.
M-I L.L.C., operating as M-I SWACO (Schlumberger Ltd.)	Lander	Battle Mountain	XX.
Drilling Mineral Industries, LLC	Elko	Osino	XX.
Ohio:			
CIMBAR Performance Minerals, Inc.	Columbiana	Wellsville	XX.
Do.	Washington	Marietta	XX.
Tennessee, Excalibar Minerals LLC	Dyer	Dyersburg	XX.
Texas:			
CIMBAR Performance Minerals, Inc.[4]	Nueces	Corpus Christi - CC	No. 122, Corpus Christi, TX.
Do.[5]	do.	Corpus Christi - TC	Do.
CIMBAR Performance Minerals, Inc.	Harris	Houston	XX.
Excalibar Minerals LLC (Newpark Resources, Inc.)	do.	do.	XX.
Do.	Nueces	Corpus Christi	No. 122, Corpus Christi, TX.
Halliburton Energy Services, Inc. (Halliburton Co.)	do.	do.	Do.
Milwhite Inc. (Control MINAR, S.A. de C.V.)	Cameron	Brownsville	XX.
Superior Weighting Products, LLC (CES Energy Solutions Corp.)	Nueces	Corpus Christi	No. 122, Corpus Christi, TX.

Do., do. Ditto. XX Not applicable.
[1]Table includes data available through July 14, 2022.
[2]Inactive in 2021.
[3]In temporary closure for most of the year. Restarted operations at yearend 2021.
[4]Processes barite for use in oil- and gas-drilling fluids.
[5]Processes barite for use in paint.

TABLE 3
CRUSHED AND GROUND BARITE SOLD OR USED BY PROCESSORS
IN THE UNITED STATES, BY STATE[1, 2]

State	2020 Number of plants	2020 Quantity (thousand metric tons)	2020 Value (thousands)	2021 Number of plants	2021 Quantity (thousand metric tons)	2021 Value (thousands)
Louisiana	5	516	$67,400	5	483	$63,900
Texas	8	498	82,700	8	652	106,000
Other[3]	10	392	107,000	10	538	110,000
Total	23	1,410	257,000	23	1,670	280,000

[1]Table includes data available through July 14, 2022. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]From domestically mined and imported crude barite.
[3]Includes California, Georgia, Nevada, Ohio, and Texas.

TABLE 4
CRUSHED AND GROUND BARITE SOLD OR USED BY PROCESSORS
IN THE UNITED STATES, BY USE[1, 2]

Use	2020 Quantity (thousand metric tons)	2020 Value (thousands)	2021 Quantity (thousand metric tons)	2021 Value (thousands)
Barium chemicals, filler and (or) extender, glass, paint, rubber	W	W	W	W
Well drilling	W	W	W	W
Total	1,410	$257,000	1,670	$280,000

W Withheld to avoid disclosing company proprietary data.
[1]Table includes data available through July 14, 2022. Data are rounded to no more than three significant digits.
[2]From domestically mined and imported crude barite.

TABLE 5
U.S. EXPORTS OF NATURAL BARIUM SULFATE (BARITE), BY COUNTRY OR LOCALITY[1, 2]

Country or locality	2020 Quantity (metric tons)	2020 Value (thousands)	2021 Quantity (metric tons)	2021 Value (thousands)
Canada	22,000	$5,980	39,800	$8,610
China	177	156	88	59
Colombia	805	296	83	60
Dominican Republic	230	106	--	--
El Salvador	75	25	526	525
Guadeloupe	--	--	549	227
Guyana	18,200	2,630	5,210	2,040
Mexico	5,270	5,090	14,500	8,950
Thailand	264	121	271	110
Trinidad and Tobago	240	68	43	46
Other[3]	537 r	435 r	468	546
Total	47,800	14,900	61,600	21,200

rRevised. -- Zero.
[1]Table includes data available through June 9, 2022. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Imports calculated from Schedule B numbers 2511.10.0000 and 2833.27.0000.
[3]Includes countries and (or) localities with less than 100 metric tons each.

Source: U.S. Census Bureau.

TABLE 6
U.S. IMPORTS OF BARITE, BY COUNTRY OR LOCALITY[1, 2]

	Imports for consumption[3]				General imports[4]			
	2020		2021		2020		2021	
Country or locality	Quantity (metric tons)	Value[5] (thousands)	Quantity (metric tons)	Value[5] (thousands)	Quantity (metric tons)	Value[5] (thousands)	Quantity (metric tons)	Value[5] (thousands)
Crude:								
China	104,000	$17,200	167,000	$27,400	140,000	$20,700	322,000	$44,900
Hong Kong	--	--	5,180	159	--	--	5,180	159
India	84,300	6,740	71,800	7,050	412,000	40,800	396,000	42,900
Mexico	47,500	5,660	53,100	6,650	47,300	5,650	82,900	9,270
Morocco	37,200	4,500	138,000	14,100	32,800	2,880	432,000	41,300
Pakistan	--	--	--	--	--	--	10,100	1,740
Thailand	51,600	6,770	--	--	51,600	6,770	--	--
United Kingdom	5,420	196	5,340	170	5,420	196	5,340	170
Vietnam[6]	--	22,700	--	17,400	--	22,300	--	17,400
Other [2 countries and (or) localities]	--	--	507	47	--	--	507	47
Total	330,000	63,800	441,000	73,000	689,000	99,400	1,250,000	158,000
Ground:								
China	467,000	41,200	345,000	33,900	823	353	174	171
Germany	1,910	1,890	2,700	2,660	1,910	1,890	2,700	2,660
India	394,000	35,100	393,000	37,700	--	--	9,000	1,030
Mexico	166,000	20,800	184,000	21,200	164,000	20,600	152,000	18,800
Morocco	110,000	10,800	267,000	20,500	--	--	3,000	367
Pakistan	--	--	9,970	1,700	--	--	--	--
Other [6 countries and (or) localities]	206	100	676	512	206	100	676	512
Total	1,140,000	110,000	1,200,000	118,000	166,000	23,000	168,000	23,500
Other sulfates of barium:								
China	4,620	3,170	6,380	5,420	4,620	3,160	6,380	5,420
Finland	--	--	15	21	--	--	15	21
Germany	3,990	10,600	4,370	11,500	3,990	10,600	4,370	11,500
Hong Kong	252	159	198	192	252	159	198	192
India	--	--	14	57	--	--	14	57
Italy	3,800	4,470	4,060	4,950	3,800	4,470	4,060	4,950
Japan	497	1,320	747	2,090	497	1,320	747	2,090
Mexico	13	27	4	8	13	27	4	8
Spain	19	31	9	17	19	31	9	17
Switzerland	92	87	60	45	92	87	60	45
United Kingdom	38	57	1	10	38	57	1	10
Other [2 countries and (or) localities]	5	8	8	16	5	8	8	16
Total	13,300	19,900	15,900	24,300	13,300	19,900	15,900	24,300
Grand total	1,480,000	194,000	1,660,000	215,000	869,000	142,000	1,440,000	206,000

-- Zero.
[1]Table includes data available through July 18, 2022. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Imports calculated from Harmonized Tariff Schedule of the United States codes 2511.10.1000, 2511.10.5000, and 2833.27.0000.
[3]Imports for consumption data specify crude barite processed in free trade zones as ground.
[4]General import data specify the form of imported barite at the time it enters the United States.
[5]Cost, insurance, and freight value.
[6]Referred to U.S. Census Bureau for verification.

Source: U.S. Census Bureau.

TABLE 7
U.S. IMPORTS FOR CONSUMPTION OF BARIUM CHEMICALS[1, 2]

	2020		2021	
	Quantity (metric tons)	Value[3] (thousands)	Quantity (metric tons)	Value[3] (thousands)
Barium chloride	1,860	$1,750	1,620	$1,690
Barium oxide, hydroxide, peroxide	2,950	5,500	3,400	6,260
Barium carbonate, precipitated	1,440 r	2,010	1,590	3,150

rRevised.
[1]Table includes data available through June 9, 2022. Data are rounded to no more than three significant digits.
[2]Imports calculated from Harmonized Tariff Schedule of the United States codes 2816.40.2000, 2827.39.4500, and 2836.60.0000.
[3]Cost, insurance, and freight value.

Source: U.S. Census Bureau.

TABLE 8
BARITE: WORLD PRODUCTION, BY COUNTRY OR LOCALITY[1]

(Metric tons)

Country or locality[2]	2017	2018	2019	2020	2021
Algeria, crude	44,812 r, 3	39,426 3	31,138 r	32,940 r	33,000 e
Argentina	5,977	7,225	3,898	4,000 e	4,000 e
Australia	8,958	6,534	1,982	--	1,127
Bolivia	29,114	53,163	39,458	9,611	27,000 e
Bulgaria[e]	67,000	70,000	72,000	41,000	72,000
Burma	3,206	2,935	13,045	2,642 r	2,220
Canada[e]	50,000	40,000	40,000	50,000	50,000
China[e]	3,200,000 r	2,400,000 r	2,300,000 r	1,700,000 r	2,100,000
Ecuador	--	2,868	3,000 e	3,000 e	3,000 e
Germany	34,177	37,897	30,474	26,656 r	27,000 e
Guatemala	43	63	60 e	-- r	--
India	2,038,915 4	2,390,000 e	2,100,000 e	1,600,000 e	1,600,000 e
Iran	239,132 5	201,721	224,412 r	224,000 r, e	224,000 e
Kazakhstan	569,900	570,000 e	530,600	445,300	450,000 e
Laos	75,000 e	230,000 e	486,009	96,278 r	37,403
Liberia	--	--	12,000 e	-- e	--
Mexico	359,912	366,234	378,295	372,262 r	320,642
Morocco, crude	818,010	899,365	1,100,000 e	410,000 e	1,100,000 e
Nigeria	714	83 r	348 r	350 r, e	350 e
Pakistan	105,554	99,286	85,992	100,000 r, e	140,000 e
Peru	9,182	15,621	16,373	5,252	10,361
Russia	178,000	163,000	228,000	287,000	150,000 e
Slovakia	15,690	9,500	5,770	5,800 e	5,800 e
Thailand	147,954	67,490	33,644	22,394 r	22,000 e
Turkey, crude and ground	310,667	335,473	299,000 r, e	258,000 r, e	258,000
United Kingdom	55,000	55,000	50,000	50,000	50,000 e
United States, crude[6]	334,000	366,000	414,000	W	W
Vietnam[e]	26,000	41,000	31,000	43,000	43,000
Total	8,730,000 r	8,470,000 r	8,530,000 r	5,790,000 r	6,730,000 e

eEstimated. rRevised. W Withheld to avoid disclosing company proprietary data. -- Zero.
[1]Table includes data available through June 23, 2022. All data are reported unless otherwise noted; totals may include estimated data. Totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.
[2]In addition to the countries and (or) localities listed, Afghanistan, Egypt, Italy, and some other countries and (or) localities may have produced barite, but available information was inadequate to make reliable estimates of output.
[3]Data as reported by the Algeria Office of National Statistics only included production from state-owned entities.
[4]Data are for year beginning April 1 of that stated.
[5]Data are for year beginning March 20 of that stated.
[6]Crude barite sold or used by producers.

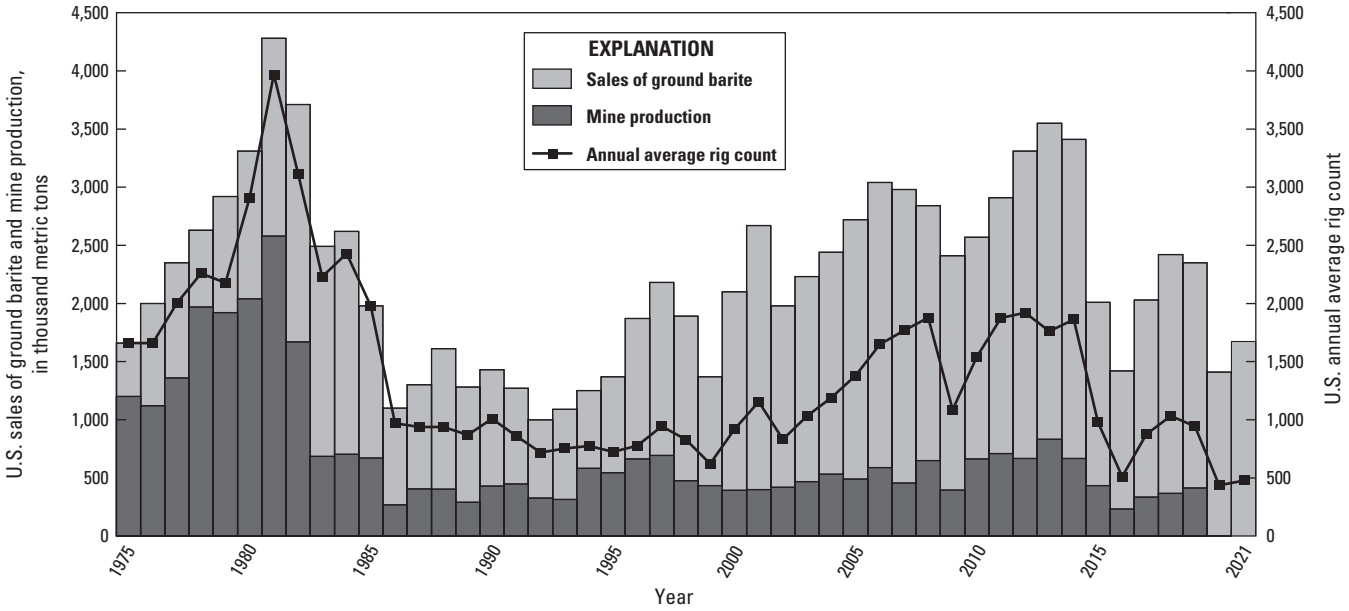

Figure 1. Historical trends in sales of ground barite, mine production of barite, and annual average rig count in the United States from 1975 through 2021. Mine production in 2020 and 2021 was withheld to avoid disclosing company proprietary information. Sales of ground barite include domestically mined and imported crude barite. Sources: Baker Hughes Co. and the U.S. Geological Survey.