BARITE

By James P. Searls

Barite, a name which was derived from the Greek word "barus," meaning heavy, is the mineralogical name for barium sulfate. In commerce, the mineral is sometimes referred to as "heavy spar" or "barytes." "Spar" means almost any transparent or translucent, readily cleavable, crystalline mineral having a vitreous luster (Thrush, 1968). Few mines in the United States produce a spar grade barite.

As used in this report, the term "primary barite" refers to the first marketable product. This product includes crude barite and the products of simple beneficiation methods, such as washing, jigging, heavy media separation, tabling, flotation, and magnetic separation. Most primary barite requires grinding to a small, uniform size before it is used as a weighting agent in petroleum well drilling mud [American Petroleum Institute (API) or Oil Companies' Materials Association (OCMA) specification barite] or as an addition to industrial products. Barite used for drilling can be blue, black, brown, or gray depending on the ore body; must be finely ground, dense, soft, and chemically inert; must have a specific gravity of 4.2 or greater; must be free of soluble salts; and 90% to 95% of the material must pass through a 325-mesh screen. A small percentage of iron oxide is allowable. In offshore drilling the U.S. Environmental Protection Agency limits the content of mercury to 1 milligram per kilogram of barite, and the content of cadmium to 3 milligrams per kilogram of barite (U.S. Environmental Protection Agency, 1997).

Production

Domestic sales data for barite were derived from a voluntary survey of U.S. operations by the U.S. Geological Survey (USGS). Actual mine production data were not collected because some mines sporadically produce stocks of raw ore, then beneficiate and sell from those stocks for several years. Of the 27 operations to which a survey was sent, 27 reported, representing 100% of the primary barite sold or used by producers. Grinding to API specifications was not usually performed at the mine site because railroad tariffs were higher for finished barite than for crude barite, although some barite was ground at the mine sites in Nevada to supply the Western States, the Western Canadian provinces, and Alaska. Using a verbal, rounded total, the Geological Survey estimated the sales from two grinding plants of imported barite, resulted in data for 29 operations. Of the 27 operations surveyed, 8 were mines, 7 of which had associated beneficiating mills, and 1 mine only sold run-of-mine ore (on a contract basis). In addition, less than 40,000 tons included in the "Quantity" in table 2 was from stocks of a closed mine that was not counted in the "Number of Operations." Mountain Minerals' Elk Creek Mine, was reported by company office staff as depleted and likely to be permanently closed. Baker-Hughes' Miller Mine in Nevada was reported by management as remaining idle. The quantity of primary barite sold or used by producers rose by about 22% from that of 1995 while weighted average prices rose about 16%.

There are 15 barite crushing or grinding operations not geographically associated with mines, which are near the consumers of barite in Illinois, Louisiana, and Texas, and receive imported and some domestic barite for processing. Of those operations, Circle A Construction Inc.'s grinding plant in Elko County, NV, Old Soldier's grinding plant in Abbeville, LA, and Milwhite's grinding plant in Houston, TX, were idled during the year. Excalibar Minerals Inc. opened two grinding plants, one each in Abbeville, LA and Houston, TX, in 1996. The quantity of crushed and ground barite sold rose by about 36% from that of 1995, and the weighted average price rose a modest, approximate 4% from that of 1995.

Consumption

Domestic producers supplied a broad range of barite quality, excluding only the United States Pharmacopoeia barite. Crushing and grinding companies reported only a division of sales between petroleum-well weighting barite and "industrial" barite.

About 94% of the barite sold in the United States was used as a weighting agent in oil- and gas-well drilling fluids, mostly in the Gulf of Mexico region and much smaller amounts used in the Pacific Coast areas. Domestic API barite consumption was driven by oil and gas drilling activity, particularly in those wells that were deeper than about 2,135 meters (7,000 feet) where the petroleum-reservoir pressure increases at a greater rate than hydraulic pressure. Owing to its specific gravity of at least 4.2, barite, which is an environmentally beneficial mineral, is used in slurry form to counterbalance any upwardly vented pretoleum-reservoir pressure. When drilling through fluidized zones, the added weight of the barite slurry creates a hydrostatic pressure that holds back formation pressures and prevents an influx of fluids from the formation into the oil drill hole. Uncounterbalanced petroleum reservoir pressure would allow the crude oil and gas to gush (spray) out of the well. Gushers of crude petroleum were, and still are, extremely dangerous fire hazards, wasteful of crude petroleum, and sources of visual and chemical pollution to the surface area surrounding the well.

Demand for petroleum-well weighting barite (API) rose strongly between 1995 and 1996 owing to deep oil- and gas-

well drilling off the coasts of Louisiana and Texas and a technological shift within the last 3 years in the well drilling industry that made drilling more efficient and lowered the cost of petroleum wells. This shift led to a resurgence of drilling in the United States and the adjacent Gulf Coast. Additionally, the major international U.S. oil and gas producers and sellers have turned their attention back to the Gulf Coast because of the slow development of the giant international opportunities; other opportunities were also reported onshore (Oil & Gas Journal, 1997b).

Traditionally, the U.S. demand for barite has been explained by the prices of the petroleum products through the numbers of drill rigs used in the United States during the reported year, and this was a partial explanation for 1996. By the yearend, the week-average futures price for light sweet crude oil had risen from $19.17 per barrel at yearend 1995 to $25.85 per barrel (Oil & Gas Journal, 1997c). At midyear 1996, the price for light sweet crude oil was $20.99 per barrel, up more than 9% from yearend 1995 and more than 18% from the midyear 1995 price of $17.74 per barrel (Oil & Gas Journal, 1996a). From midyear 1995 to year end 1996, the week-average futures price for light sweet crude oil increased 46% . The natural gas week-average futures price increased 52% from $2.85 per million British thermal units at the beginning of 1996 to $4.34 per million British thermal units at yearend (Oil & Gas Journal, 1997c), and a 175% increase from midyear 1995. Most of the increase in price occurred in the second half of the year for the midyear price for 1996 was $ 2.61 per million British thermal units (Oil & Gas Journal, 1996b).

The number of gas-directed rigs, as reported by the Baker-Hughes rotary rig count, was 362 rigs in mid-year 1995, 420 at yearend 1995, 465 at midyear 1996, and 496 at yearend 1996 (Oil & Gas Journal, 1997a, 1996a). The Baker-Hughes "Total U.S." rotary rig count at the ends of the years increased by about 14% to 851 rigs at the end of 1996 from 745 rigs at the end of 1995 (Oil & Gas Journal, 1997a).

No subdivisions of industrial enduses of barite are reported because each is less than about 20,000 tons per year. The technical grade end uses are for filler and extender grades, colorants, weighting agents, and feedstock into barium chemicals (Brobst, 1994, p. 131). The construction industry uses marble-sized lumps of barite as a portion of the aggregate in concrete to weight down petroleum pipelines passing through marshes or under rivers. The same sizes will also block radiation in concrete nuclear reactor buildings. The industrial enduses of barite included: barium chemicals for the glass, ceramic products, brick and cement block industries; and barium ferrites and titanates; batteries; brake and clutch pads for automobiles and trucks; gastrointestinal x-rays; paint; rubber; plastics; and photographic print paper. One domestic barite producer has named its white technical grade barite "baryte" to distinguish it from the barite used in petroleum well-drilling. A very small amount was used in research on superconducting materials. Barite used as industrial-grade weighting agents encompass such products as barite in rubber mud flaps for trucks to prevent the flap from being lifted by the air flow around the truck, and in rubber rug backing to keep the rug more stationary.

Prices

Between 1995 and 1996 the USGS revised the nominal average weighted 1995 price of all primary barite sold by U.S. producers to $19.20 per ton. The 1996 nominal average weighted sales price for primary barite was $22.14 per ton in 1996, an increase of 15% from the recalculated 1995 prices. Nominal average prices for the crushed and ground barite rose from $73.03 per ton in 1995 to $75.44 per ton in 1996, an increase of more than 3%. International prices for the middle of the year, as reported in Industrial Minerals, (1996c) were as follows: API, lump, c.i.f. (cost, insurance, and freight) [U.S.] Gulf Coast, Chinese, $51 to $55, Indian, $49 to $52, Moroccan, $49 to $51; unground, OCMA/API, bulk, specific gravity 4.2, f.o.b. (free on board) Morocco, $39 to $41 per ton; ground, bagged, specific gravity 4.22, f.o.b. Morocco, $75 to $80 per ton; ground OCMA/API, big bags (1.5 tons) f.o.b. South Turkey, $60 to $64 per ton; ground OCMA, bulk, delivered Aberdeen [United Kingdom], $69.68 to $80.52 [£45-£52; International Monetary Fund (1996)] per ton, delivered Great Yarmouth [United Kingdom], $80.52 to $92.91 (£52-£60) per ton; micronised, off-white minimum 99% less than 20 micronmeters delivered United Kingdom, $216.78 to $232.27 (£140-£150) per ton, and ground, white paint-grade 96% to 98% $BaSO_4$, 350 mesh, 1 to 5 tons delivered United Kingdom, $301.95 to $340.66 (£195-£220) per ton. The weighted, average c.i.f. price of Chinese exported, lump or crude barite into the U.S. Gulf Coast has risen from $40.83 per ton in 1993 (U.S. Bureau of Mines, 1993) to $52.39 per ton (table 6). China is the world's largest producer and will likely set the lowest delivered price for barite around the world.

World Review

Algeria.—In September, M-I finalized a joint venture agreement with Sonatrach, the state oil company of Algeria (Smith International, Inc., 1997). This joint venture, M-I Algeria S.P.A., will supply an extensive line of drilling, completion and workover fluids as well as advanced production chemicals.

Canada.—In 1994, Mountain Minerals Co. Ltd. entered a joint venture project in China with the Guizhou Provincial Metals and Minerals I/E Corp. (Industrial Minerals, 1996a). The project is a barite grinding plant in the Guizhou Province to supply the Asian market.

Morocco.—In June, M-I Drilling Fluids [owned by Smith International, Inc. (64%) and Halliburton Co. (36%)] bought Anchor Drilling Fluids, A.S. from Transocean A.S. (Norwegian) for US$105 million (Smith International, Inc., 1996). Among its assets, Anchor owned 60% of Compagnie Marocaine des Barytes, which operated the Zelmou barite mine in the Figuig Province and a 60,000-ton-per-year processing plant in Safi. Anchor has experience supplying the North Sea and West African markets.

Nigeria.—Baroid Drilling Fluids Inc.'s Baroid Nigeria Ltd. entered into a joint venture, called Baroid Drilling Chemical Products Limited, with the Nigerian Barytes Mining and Processing Co. to mine barite in Azara, Plateau State (Industrial Minerals, 1996b). Nigerian Barytes Mining and Processing Co. is a subsidiary of the Nigerian Mining Corp. Baroid owns 60% of the joint venture. The Government of Nigeria has banned the importation of barite to encourage local production to meet the local consumption of about 75,000 tons per year.

Outlook

If the oilfield projects in other countries around the world remain at 1996 levels, then the U.S. market for barite could be healthy for several years. The small market for exported U.S. barite is not likely to change.

It is not clear how long or to what extent the futures price for gas or oil will rise in the next 2 years. If futures oil and gas prices stay above yearend 1993 levels, then the demand for barite should increase. This could allow a price rise in constant dollars and maybe return some idle mines to activity. It is hard, however, to forecast the percentage split of the supply of barite between U.S. mines and imported barite after noting the rising prices for barite imported from China.

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[1]Prior to January 1996, published by the U.S. Bureau of Mines.

TABLE 1
SALIENT BARITE AND BARIUM CHEMICAL STATISTICS 1/ 2/

(Thousand metric tons and thousand dollars)

	1992	1993	1994	1995	1996
United States:					
Barite, primary:					
Sold or used by producers	326	315 3/	583	543	662
Value	$19,600	$19,300 3/	$19,100	$10,400 r/	$14,700
Exports	12	18	14	16	31
Value	$1,810	$2,610	$1,850	$2,020	$3,190
Imports for consumption 4/	354	804	1,070	1,040	1,540
Value	$17,300	$34,200	$47,200	$52,500	$81,900
Consumption (apparent) 5/	668	1,100	1,640	1,570	2,170
Crushed and ground (sold or used by processors) 6/	999	1,090	1,250	1,370 r/	1,870
Value	$84,400	$79,200	$81,100	$99,800 r/	$141,000
World: Production	4,570 r/	4,250 r/	4,260 r/	4,300 r/	4,460 e/

e/ Estimated. r/ Revised.

1/ Data are rounded to three significant digits.

2/ Barium chemicals data withheld to avoid disclosing company proprietary data.

3/ Data excludes run of mine.

4/ Includes crude and ground.

5/ Sold or used plus imports minus exports.

6/ Includes imports.

TABLE 2
U.S. PRIMARY BARITE SOLD OR USED BY PRODUCERS, BY STATE 1/

		Total	
State	Number of operations	Quantity (thousand metric tons)	Value (thousands)
1995:			
Nevada	5 2/	479	$7,950
Other States 3/	5 r/	64	2,480 r/
Total	10 r/	543	10,400 r/
1996:			
Nevada	5 2/	W	W
Other States 3/	4	W	W
Total	9	662	14,700

r/ Revised. W Withheld to avoid disclosing company proprietary data; included in "Total."

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Includes one idle mine.

3/ Includes Georgia, Illinois (1995), Missouri, and Tennessee.

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

	1995			1996		
State	Number of plants	Quantity (thousand metric tons)	Value (thousands)	Number of plants	Quantity (thousand metric tons)	Value (thousands)
Louisiana	5	762 r/	$55,300 r/	7	1,090	$80,500
Nevada	4	245 r/	8,800 r/	3	238	10,200
Texas	3 r/	W	W	5	454	33,900
Other 3/	7 r/	359 r/	35,600 r/	6	81	16,100
Total	19 r/	1,370 r/	99,800 r/	21	1,870	141,000

r/ Revised. W Withheld to avoid disclosing company proprietary data; included with "Other."

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Includes imports.

3/ Includes California, Georgia, Illinois, Missouri, and States indicated by the symbol "W."

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

(Thousand metric tons and thousand dollars)

Use	1995 r/		1996	
	Quantity	Value	Quantity	Value
Barium chemicals, filler and/or extender, glass	100	$17,700	102	$16,600
Well drilling	1,270	82,100	1,760	124,000
Total	1,370	99,800	1,870	141,000

r/ Revised.
1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Includes imports.

TABLE 5
U.S. EXPORTS OF NATURAL BARIUM SULFATE (BARITE), BY COUNTRY 1/

Country	1995		1996	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Argentina	26	$42	35	$6
Belgium	--	--	24	6
Brazil	4	7	--	--
Canada	14,000	1,140	12,800	1,140
Chile	--	--	1,440	242
Colombia	10	6	33	34
Egypt	--	--	81	35
France	3	6	1	4
Germany	--	--	150	6
Greece	40	9	--	--
Hong Kong	--	--	152	132
Israel	10	56	--	--
Italy	--	--	48	211
Japan	18	293	27	11
Korea, Republic of	--	--	22	15
Mexico	1,430	428	9,660	798
Netherlands	--	--	6	4
Oman	--	--	32	118
Panama	--	--	20	8
Spain	20	5	--	--
Suriname	36	6	--	--
Switzerland	7	12	--	--
Taiwan	19	7	--	--
Thailand	--	--	4	7
United Kingdom	--	--	1	6
Venezuela	--	--	5,960	415
Total	15,600	2,020	30,500	3,190

1/ Data are rounded to three significant digits; may not add to totals shown.

Source: Bureau of the Census.

TABLE 6
U.S. IMPORTS FOR CONSUMPTION OF BARITE, BY COUNTRY 1/

Country	1995 Quantity (metric tons)	1995 Value 2/ (thousands)	1996 Quantity (metric tons)	1996 Value 2/ (thousands)
Barite, crude:				
Canada	87	$27	12,700	$2,620
China	699,000	33,900	1,130,000	59,200
India	216,000	7,760	244,000	9,220
Japan	--	--	341	10
Mexico	10,700	474	25,000	1,270
Morocco	38,400	1,890	39,000	1,950
Netherlands	25	15	--	--
Switzerland	--	--	12,100	541
United Kingdom	1	8	--	--
Total	965,000	44,100	1,470,000	74,800
Barite, ground:				
Canada	11,600	2,850	1,500	999
Germany	231	124	55	48
Japan	65	65	--	--
Mexico	66,400	5,360	68,800	5,970
Netherlands	49	25	111	46
United Kingdom	--	--	1	2
Total	78,400	8,430	70,400	7,060

1/ Data are rounded to three significant digits; may not add to totals shown.
2/ C.i.f. value.

Source: Bureau of the Census.

TABLE 7
U.S. IMPORTS FOR CONSUMPTION OF BARIUM CHEMICALS 1/

	1995 Quantity (metric tons)	1995 Value 2/ (thousands)	1996 Quantity (metric tons)	1996 Value 2/ (thousands)
Barium choride	1,110	$651	1,680	$1,260
Barium oxide, hydroxide, and peroxide	4,410	4,890	4,380	4,850
Barium nitrate	3,950	3,450	3,880	2,930
Barium carbonate, precipitated	20,500	13,200	18,900	13,100
Other barium compounds	13,400	13,000	12,400	12,700

1/ Data are rounded to three significant digits.
2/ C.i.f. value.

Source: Bureau of the Census.

TABLE 8
BARITE: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country 3/	1992	1993	1994	1995	1996 e/
Afghanistan e/ 4/	2,000	2,000	2,000	2,000	2,000
Algeria	51,159	47,232	20,590	25,000 e/	25,000
Argentina	10,015	14,761 r/	27,952 r/	27,000 r/ e/	27,000
Australia e/	11,000	11,000	11,000	11,000	11,000
Belgium e/	30,000	30,000	30,000	30,000	30,000
Bolivia	368	-- e/	3,307	10,845	2,000
Bosnia and Herzegovina e/ 5/	3,000	2,000	1,000	1,000	500
Brazil (beneficiated)	54,490	32,068	31,499	30,750 r/	32,000
Burma	13,589	15,628	21,969	34,601	26,000
Canada	37,000	59,000	55,000	61,000 r/	61,000 p/
Chile	2,514	2,035	3,670	3,000 e/	3,000
China e/	1,500,000	1,500,000	1,500,000	1,500,000	1,500,000
Colombia	9,380	4,840	7,000	21,300	21,000
Croatia e/ 5/	1,500	1,500	1,000	1,000	500
Czechoslovakia 6/ 7/	31,313	XX	XX	XX	XX
Egypt	7,840	1,125	419	500 e/	500
France	96,200 r/	67,200 r/	72,100	75,450 r/	75,000
Georgia e/	40,000	30,000	20,000	20,000	20,000
Germany (marketable)	154,873	147,614	145,223	150,000 e/	150,000
Greece (crude ore) e/	1,000	1,000	1,000	1,000	1,000
Guatemala e/	1,720 8/	1,500	1,000	1,200	1,250
India	458,436	547,875	497,971 r/	420,704 r/	500,000
Iran 4/	181,174	226,378	139,000 e/	150,000 e/	150,000
Ireland	70,600	53,000 e/	-- r/	10,000 r/	10,000
Italy e/	74,884 8/	52,000	60,000	38,000	40,000
Kazakstan e/	300,000 r/	300,000 r/	300,000 r/	286,000 r/	250,000
Kenya	100 e/	14	20 r/	20 r/ e/	20
Korea, Republic of	40	--	85	90 r/	80 8/
Malaysia	10,525	11,551	17,144	16,966	21,000
Mexico	187,730	136,000	86,605	248,367	250,000
Morocco	401,000	325,200	264,526	265,000 e/	265,000
Pakistan	32,432	26,336	20,320	15,360	16,000
Peru	16,579	23,988	53,074	37,420	37,500
Philippines e/	500	500	500	500	500
Poland	14,000 r/	20,400 r/	26,600 r/	22,400 r/	25,000
Portugal e/	378 8/	350	50 r/	50 r/	60
Romania	118,100	115,000 e/	104,700	18,169 r/	12,541 8/
Saudi Arabia	--	2,000	5,000	6,000	8,000 8/
Slovakia e/ 7/	XX	30,000	25,000	25,000	25,000
South Africa	3,570	2,000	1,945	1,990	7,428 8/
Spain	6,194	17,656 r/	28,037 r/	28,600 r/	28,000
Thailand	46,328	42,385	53,248	58,807 r/	59,000
Tunisia	30,179	30,000 e/	10,465 r/	15,200	16,000
Turkey (run-of- mine)	311,335	118,367	116,220	158,000 e/	144,000
United Kingdom	76,723	32,623 r/	54,000	85,000 e/	102,000 8/
United States 9/	326,000	315,000 10/	583,000	543,000	662,000 8/
Zimbabwe	232	120	--	--	--
Total	4,570,000 r/	4,250,000 r/	4,260,000 r/	4,300,000 r/	4,460,000

e/ Estimated. p/ Preliminary. r/ Revised. XX Not applicable.

1/ World totals, U.S. data, and estimated data are rounded to three significant digits; may not add to totals shown.

2/ Table includes data available through June 10, 1997.

3/ In addition to the countries listed, Bulgaria also produces barite, but available information is inadequate to make reliable estimates of output levels.

4/ Data are for fiscal year beginning Mar. 21 of that stated.

5/ Barite concentrates.

6/ Dissolved Dec. 31, 1992.

7/ All production in Czechoslovakia for 1992 came from Slovakia.

8/ Reported figure.

9/ Sold or used by producers.

10/ Data excludes run-of-mine.