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2007 Minerals Yearbook

ZIRCONIUM AND HAFNIUM [ADVANCE RELEASE]

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Zirconium and Hafnium

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The principal economic source of zirconium is the zirconium silicate mineral zircon ($ZrSiO_4$). A relatively small quantity of zirconium is derived from the mineral baddeleyite, a natural form of zirconium oxide or zirconia (ZrO_2). In 2007, the leading producers of zircon were Australia and South Africa. Baddeleyite was produced from a single source at Kovdor, Russia. The leading producers of zirconium metal were France, Russia, and the United States.

World production of zirconium mineral concentrates in 2007, excluding U.S. production, was about 1.42 million metric tons (Mt), compared with 1.25 Mt in 2006. Because of the closure of mines in Florida and Georgia, domestic production of zircon decreased in 2007 compared with production in 2006. Production of milled zircon and zirconium oxide increased compared with that of 2006. The United States was a net exporter of zirconium ore and concentrates. U.S. imports of zirconium ore and concentrates decreased by 45% compared with those of 2006, and domestic exports of zirconium ore and concentrate decreased by 13%. Prices for zirconium mineral concentrates increased; however, increased production resulted in declining prices at yearend.

With the exception of prices and referenced data, all survey data in this report have been rounded to no more than three significant digits. Totals and percentages were calculated from unrounded numbers.

Production

Zircon is normally produced as a coproduct or byproduct of the mining and processing of heavy-mineral sands. In 2007, U.S. producers of zircon were DuPont Titanium Technologies [a subsidiary of E.I. du Pont de Nemours & Co. (DuPont)] and Iluka Resources, Inc. (a subsidiary of Australian company Iluka Resources Ltd.). DuPont produced zircon from its heavy-mineral sands operation near Starke, FL. Iluka produced zircon from its heavy-mineral sands operations at Stony Creek, VA.

Zircon is the primary source of hafnium. Zirconium and hafnium are contained in zircon at a ratio of about 50 to 1. Zircon is a coproduct or byproduct of the mining and processing of heavy-mineral sands for the titanium minerals ilmenite and rutile or for tin minerals.

Data for zirconium and hafnium manufactured materials are developed by the U.S. Geological Survey from a voluntary survey of domestic operations. Of the 44 operations surveyed, 32 did not respond. Data for nonrespondents were estimated on the basis of prior-year levels.

Data for zircon concentrates are developed by a second voluntary survey of domestic mining operations. Of the two domestic zircon producers, 100% responded. Data on domestic production and consumption of zircon concentrates were withheld to avoid disclosing company proprietary data.

Domestic production of milled zircon and zirconium oxide was 37,000 metric tons (t) and 25,600 t, respectively (table 1). Domestic production of zircon concentrate in 2007 decreased compared with that of 2006.

Iluka's production of zircon concentrate in Virginia decreased 14% compared with that in 2006. In December, Iluka's board of directors approved the development of the Brink deposit to support the continued operation of its Stony Creek mining operations. The Brink deposit is about 48 kilometers south of the Stony Creek mining operations. The development of the Brink deposit was expected to extend the economic life of the Virginia operations from 2012 to 2014 (Iluka Resources Ltd., 2008a, p. 14, 23).

U.S. producers of zirconium and hafnium metal were Wah Chang (an Allegheny Technologies, Inc. company), Albany, OR, and Western Zirconium (a subsidiary of Westinghouse Electric Co.), Ogden, UT. Primary zirconium chemicals, those produced directly from zircon, were produced by Wah Chang and Magnesium Elektron Inc., Flemington, NJ. Secondary zirconium chemicals, produced from intermediate zirconium chemicals, were produced by about 10 companies. Zirconia was produced from zircon sand at plants in several States.

In April, the multinational company Imerys Group acquired UCM Group PLC, a leading producer of fused zirconia with operations in the United Kingdom and the United States. Universal America Inc. (UAI), Greeneville, TN, was UCM's principal site for the production of monoclinic and stabilized zirconia. UAI has a production capacity of more than 10,000 metric tons per year (t/yr). In addition, UCM's Unitec Ceramics, Stafford, United Kingdom, produced fine-sized zirconia for the advanced ceramics market (Imerys AS, 2008, p. 17, 19, 158).

Consumption

In 2007, global demand for zircon was estimated to be 1.3 Mt, a 2.6% increase compared with demand in 2006. Globally, the major end uses of zircon were, in descending order of quantity, ceramics, zirconia and zirconium chemicals, and foundry and refractories. In the United States, the major end uses of zircon were, in descending order of quantity, refractories, foundry sands (including investment casting), and ceramic opacification (TZ Mineral International Pty. Ltd., 2007, p. 3). Zircon is also marketed as a natural gemstone and is processed to produce cubic zirconia, a diamond and colored gemstone simulant. Zirconium metal is used in corrosive environments, nuclear fuel cladding, and various specialty alloys. The principal uses of hafnium are in high-temperature ceramics, nickel-base superalloys, nozzles for plasma arc metal cutting, and nuclear control rods.

Stabilized zirconium oxide exhibits high light reflectivity and good thermal stability and is primarily used as an opacifier and pigment in glazes and colors for pottery and other ceramic products. Yttria-stabilized zirconia (YSZ) is used in the manufacture of oxygen sensors that control combustion in automobile engines and furnaces. YSZ is also used in the manufacture of a diverse array of products, including cubic zirconia, fiber optic connector components, refractory coatings, and structural ceramics. YSZ is increasingly used in dental applications as bridges, crowns, and inlays, as it has two to three times the fracture resistance and 1.4 times the strength of similar alumina products.

Zircon, used for facings on foundry molds, increases resistance to metal penetration and gives a uniform finish to castings. Milled or ground zircon is used in refractory paints for coating the surfaces of molds. In the form of refractory bricks and blocks, zircon is used in furnaces and hearths for containing molten metals. Glass tank furnaces use fused-cast and bonded alumina-zirconia-silica-base refractories. Baddeleyite is used principally in the manufacture of alumina-zirconia abrasive and in ceramic colors and refractories.

Ammonium- and potassium-zirconium carbonates are used as paper and board coatings or insolubilizers for high-quality print performance. Zirconium chemicals are also used in inks to promote adhesion to metals and plastics and as crosslinkers in polymers and printing inks.

Because of its low thermal neutron absorption cross section, hafnium-free zirconium metal is used as cladding for nuclear fuel rods. Commercial-grade zirconium, unlike nuclear grade, contains hafnium and is used in the chemical process industries because of its excellent corrosion resistance. Hafnium is used in nuclear control rods because of its high thermal neutron absorption cross section. Hafnium metal also is used as an alloy addition in superalloys.

Prices

Increasing freight and energy costs contributed to higher prices for zirconium mineral concentrates; however, increasing output from Australia and Indonesia resulted in prices easing in the second half of 2007. Australian bulk free on board (f.o.b.) zircon prices increased to $725 to $800 per metric ton at yearend 2007 from $700 to $775 per ton at yearend 2006 (table 2). The average value of imported ore and concentrates increased to $872 per ton in 2007 from $791 per ton in 2006, a 10% increase. Similarly, the average value of zircon ore and concentrates exports increased to $987 per ton in 2007 from $907 per ton in 2006, a 9% increase.

Foreign Trade

In 2007, the United States was a net exporter of zirconium ore and concentrates. U.S. exports of zirconium ore and concentrates were 66,200 t, a 13% decrease from those of 2006 (table 3). The United States also was a net exporter of zirconium and hafnium metal in 2007. U.S. exports of zirconium metal were 2,160 t, a 15% increase in quantity from the 2006 level. In 2007, the majority (85%) of zirconium metal was exported in wrought products. U.S. imports of zirconium ore and concentrates were 20,000 t, a decrease of 45% from the 36,200 t imported in 2006 (table 4). Australia and South Africa supplied 94% of the imports of ores and concentrates.

Imports of unwrought zirconium were 263 t in 2007, and the leading sources were, in descending order of quantity, France and Germany. Imports of zirconium waste and scrap were 36 t in 2007, and the leading source was France.

Domestic imports of ferrozirconium alloys were 400 t in 2007, a 103% increase from the 197 t imported in 2006. In 2007, all ferrozirconium imports originated from Brazil. U.S. imports of hafnium were about 4 t in 2007, unchanged compared with those of 2006.

World Review

Excluding U.S. production, world production of zirconium mineral concentrates in 2007 was about 1.42 Mt, a 14% increase compared with revised 2006 data (table 5). Australia and South Africa supplied about 71% of production outside the United States. World reserves of zircon are estimated to be 308 Mt of zirconium oxide content. In 2007, the heavy-mineral sands industry continued to explore and develop mineral deposits, particularly in Australia, Mozambique, South Africa, and the United States. Major zircon producers were Bemax Resources Ltd., BHP Billiton Ltd., Exxaro Resources Ltd., Iluka, and Rio Tinto Plc.

Australia.—Australian Zircon NL began production of zircon and titanium concentrates from the Mindarie mining operations near Adelaide, South Australia. The planned mine life was 12 years, based on proven and probable reserves of 59 Mt containing 4.3% heavy minerals. Australian Zircon continued prefeasibility studies of its WIM 150 deposit near Horsham in Western Victoria (Australian Zircon NL, 2008).

Bemax completed mining at its Ludlow and Tutunup South Mines in Western Australia. The company expected to continue mining at the Ginko Mine in 2008 and begin mining at the Gwindinup Mine in the first quarter of 2008. At yearend 2007, Bemax reported reserves of 11.1 Mt averaging 3.7% heavy minerals in the Murray Basin and 1.2 Mt averaging 11.8% heavy minerals in Western Australia. Bemax expected to raise its heavy-mineral production to more than 650,000 t/yr beginning in the second quarter of 2008 (Bemax Resources Ltd., 2008, p. 7-21).

Gunson Resources Ltd. formed an understanding with China Triumph International Engineering Co. (CTIEC), that would allow China National Building Material Co. (CNBM), CTIEC's parent, to take a 40% interest in the Coburn mineral sands project in Western Australia. The understanding also made CTIEC the general contractor for delivery of the project, provided that CNBM proceeded with its investment and offtake agreement for 20,000 t/yr of zircon production from Coburn. Construction of the mining operations in Western Australia and nonmagnetic mineral separation plant in China was expected to commence in early 2008. If completed, the project was expected to produce 74,000 t/yr of ilmenite, 38,000 t/yr of zircon, and 17,000 t/yr of HiTi (rutile and leucoxene). Proven and probable reserves were 124 Mt with an average heavy minerals grade of 1.3% (Gunson Resources Ltd., 2007, p. 9-11).

Iluka's Australian operations produced about 514,000 t of zircon in 2007; however, Iluka's exploration, evaluation, and development efforts in Eucla Basin and Murray Basin resulted in an increase in Iluka's reserves (Iluka Resources Ltd., 2008b). Iluka's Australian reserves of heavy minerals were estimated to have increased to 34.7 Mt, compared with 28.4 Mt in 2006. Zircon was estimated to be about 19% of the company's global heavy-mineral assemblage (Iluka Resources Ltd., 2008a, p. 97).

Matilda Minerals Ltd. extended the projected mine life of its Tiwi Islands mineral sands project to nearly 8 years from the original estimate of 4 years. In addition, Matilda announced it had completed process improvements that were expected to increase production by 30%. In its first full year of production, Matilda produced 24,730 t of heavy-mineral concentrate and began shipments of zircon concentrate to China (Matilda Minerals Ltd., 2007, p. 3, 11).

Western Australian Environmental Protection Authority recommended conditional approval of Olympia Resources Ltd.'s Keysbrook mineral sands project south of Perth. The approval was contingent on improvements to environmental conditions in areas such as dust, groundwater, and noise. Olympia planned to seek local government approval to begin mining operations in the second half of 2008 with production expected in 2009. The Keysbrook Mine was expected to produce about 100,000 t/yr of mineral product including about 15,000 t/yr of zircon concentrate during an 8-year mine life (Olympia Resources Ltd., 2007b).

Canada.—Titanium Corp. Inc. continued to pursue the recovery of heavy minerals from the Athabasca oil sands tailings in Alberta. In 2007, Titanium Corp. completed a program of process design, testing, and pilot studies, and concluded that an opportunity exists to recover bitumen as well as heavy minerals from mined oil sands tailings. In 2008, the company planned to develop integrated processes for bitumen and mineral recovery (Titanium Corp. Inc., 2007).

China.—China was a major consumer of zirconium mineral concentrates and was estimated to have imported about 430,000 t of zircon sand, flour, and concentrates, a 25% increase compared with imports in 2006. The leading import sources of zirconium mineral concentrates into China were Australia and South Africa. In addition, zircon-rich heavy-mineral concentrate was shipped to mineral separation plants in China from Indonesia and Vietnam (Mineral Sands Report, 2008).

Imerys agreed to acquire Astron Ltd.'s zircon materials, fused zirconia, and zirconium chemicals businesses in China. In 2007, Astron processed zircon from imported heavy-mineral concentrates on Hainan Island. Astron's produced about 15,000 t/yr of zircon flour for use in ceramics, specialty casting, and television glass. The company also produced a variety of zirconium-based specialty chemicals. Astron's fused zirconia production capacity was reported to be 13,000 t/yr (Imerys AS, 2007).

Zhengzhou Yuli Industrial planned to expand its fused zirconia production capacity in Zhengzhou, Henan Province, to 7,000 t/yr from 4,000 t/yr. Construction was scheduled to begin in the first quarter of 2008 and was expected to be completed by yearend (Mineral Sands Report, 2007a).

Indonesia.—Olympia Resources Ltd. was moving forward with its plans to construct mineral separation plants to produce zircon from heavy-mineral concentrate purchased from small independent mining operations in Kalimantan. In 2007, Olympia's board approved the purchase of a 10,000-t/yr zircon processing plant at Sampit in Central Kalimantan. The construction of a second processing plant at Bati Bati in Southern Kalimantan was expected to begin after the startup of the Sampit plant and was scheduled to be in production in 2008. The Bati Bati plant was expected to produce up to 23,600 t/yr of zircon concentrate. Olympia also was conducting an exploration program in Kalimantan (Olympia Resources Ltd., 2007a, p. 5-6).

Kenya.—Jinchuan Group Ltd., based in Gansu, China, acquired a 20% interest in Tiomin Resources Inc.'s Kwale mineral sands project with an option to increase its interest to 30%. In 2007, the two companies were exploring ways to jointly develop the Kwale project. Tiomin had planned to produce 40,000 t/yr of zircon from the deposit until declaring force majeure in 2006 (Tiomin Resources Inc., 2007).

Madagascar.—Production at QIT Madagascar Minerals SA (QMM) mineral sands project was expected to begin by the end of 2008 with a 40-year mine life. Production was expected to include 33,000 t/yr of zircon. QMM is a joint venture between Rio Tinto and the Madagascar Government (Rio Tinto Plc., 2008, p. 8).

Mozambique.—In April, Kenmare Resources Plc. commissioned its Moma mineral sands project. Although shipments of ilmenite commenced towards the end of 2007, shipments of rutile and zircon were not expected to begin until mid-2008. With a mine production of 800,000 t/yr of ilmenite, 56,000 t/yr of zircon, and 21,000 t/yr of rutile, the operation was expected to support a 20-year mine life (Kenmare Resources Plc., 2008, p. 12).

Russia.—Production of baddeleyite byproduct from Kovdorsky GOK's apatite and magnetite mine on the Kola Peninsula was 7,140 t, a record level. The company continued to increase production by improving recovery and reprocessing tailings (Mining Magazine, 2008).

Senegal.—Following the completion of a drilling program, Carnegie Minerals Plc. estimated the indicated mineral resource of the Niafarang mineral sands deposit to be about 600,000 t of heavy minerals. Carnegie commissioned an independent Senegalese consulting firm for an environmental impact assessment (Carnegie Minerals Plc., 2008, p. 7).

In December, Mineral Deposits Ltd. reached an agreement with the Government of Senegal to key terms in the development of the Grande Côte mineral sands project. At yearend, Mineral Deposits expected to begin production of heavy-mineral concentrates in mid-2009. When completed, heavy mineral production was expected to include 80,000 t/yr to 100,000 t/yr of zircon concentrate with a mine life of about 25 years (Mineral Deposits Ltd., 2007, p. 14).

South Africa.—In January, Exxaro (formerly Kumba Resources Ltd.) exercised an option to acquire the Namakwa Sands operation from Anglo American plc. Exxaro reported that its KwaZulu-Natal zircon production in 2007 was 34,000 t, a

32% decrease compared with that in 2006. The reduced output was attributed to lower mineral grades in the area mined, but the grades were expected to increase in 2008 (Exxaro Resources Ltd., 2008, p. 54-56). Zircon production from the Namakwa Sands operation was 114,800 t, 13,600 t less than production in 2006 (Anglo American plc, 2008, p. 161).

Mineral Commodities Ltd. continued the development of its Tormin and Xolobeni mineral sands projects. At yearend, the Department of Minerals and Energy in South Africa granted Mineral Commodities Ltd. the mining right for the Tormin deposit, and the mining right for the Xolobeni deposit was pending approval. Subject to the Xolobeni mining right being granted, a bankable feasibility study was expected to be completed in 2008 (Mineral Commodities Ltd., 2008, p. 10).

Vietnam.—The Government of Vietnam completed a study of its heavy-mineral resources. Zircon resources were estimated to be 3.4 Mt with 75% of the resources concentrated in the Binh Thuan-Vung Tau and Quang Tri-Thua Thien Hue provincial areas. The Government also forecast demand for zircon flour to increase to 40,000 t/yr from 10,000 t/yr in 2007 (Mineral Sands Report, 2007b).

Outlook

Tremendous industrial growth in China was expected to continue to increase global consumption of zircon, particularly in the form of ceramics and zircon chemicals. The rising popularity of flat-panel displays will significantly decrease demand for zircon by television glass producers, but this is not expected to significantly affect overall consumption of zircon. Global growth in the consumption of zirconium concentrates is expected to be 3% to 5% per year through the next decade. New mine production was expected to ensure adequate supply for several years. Additional expansions in supply were expected in Australia, Madagascar, Mozambique, and South Africa.

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TABLE 1
SALIENT U.S. ZIRCONIUM STATISTICS[1]

(Metric tons)

	2003	2004	2005	2006	2007
Zircon:					
Production:					
Concentrates	W	W	W	W	W
Milled zircon	35,200	31,400	31,400	33,500	37,000
Exports	70,600 r	68,800 r	101,000	76,300	66,200
Imports for consumption[2]	37,400 r	35,200 r	38,200	36,200	20,000
Consumption, apparent[3]	W	W	W	W	W
Stocks, December 31, dealers and consumers[4]	27,900	16,700	16,100	17,600	18,000
Zirconium oxide:					
Production[5]	20,400	21,300	19,900	21,700	25,600
Exports[6]	1,520	1,600	2,260	3,340	2,400
Imports for consumption[6]	2,350	3,960	3,160	2,820	3,740
Consumption, apparent[3]	20,700	23,700	21,000	24,200	26,900
Stocks, December 31, producers[5]	2,030	2,070	2,210	1,560	1,880
Zirconium; unwrought powder, waste and scrap, other:					
Exports	1,700	1,700	1,970	1,880	2,160
Imports	542	796	1,020	748 r	784
Ferrozirconium:					
Exports	1,930	913	65	491	259
Imports	154	165	306	196 r	400
Hafnium, unwrought powder, waste and scrap, other, imports	5	4	4	4	4

r Revised. W Withheld to avoid disclosing company proprietary data.
[1] Data are rounded to no more than three significant digits.
[2] Includes insignificant amounts of baddeleyite.
[3] Defined as production plus imports for consumption minus exports plus or minus government shipments.
[4] Excludes foundries.
[5] Excludes intermediate oxides associated with metal production.
[6] Includes germanium oxides and zirconium dioxides.

TABLE 2
PUBLISHED YEAREND PRICES OF ZIRCONIUM AND HAFNIUM MATERIALS

Specification of material		2006	2007
Zircon:			
Domestic, standard-grade, bulk[1]	dollars per metric ton	785	763
Imported sand, free on board, bulk[2]	do.	700-775	725-800
Baddeleyite, contract price, cost, insurance, and freight main European port:[2]			
Refractories/abrasive grade	do.	2,200-2,600	2,200-2,800
Ceramic grade (98% zirconium oxide and hafnium oxide)	do.	2,800-3,200	2,800-3,200
Zirconium oxide lot size of 1 to 10 metric tons[3]	do.	NA	6,480-12,200

do. Ditto. NA Not available.
[1]Domestic average price.
[2]Source: Industrial Minerals.
[3]Source: Stanford Materials Corp.

TABLE 3
U.S. EXPORTS OF ZIRCONIUM, BY CLASS AND COUNTRY[1]

Class and country	HTS[2]	2006 Quantity (metric tons)	2006 Value (thousands)	2007 Quantity (metric tons)	2007 Value (thousands)
Ore and concentrates:	2615.10.0000				
Argentina		1,070	$1,420	1,350	$1,480
Belgium		3,940	2,710	4,240	3,160
Brazil		2,460	3,020	2,590	3,260
Canada		12,900	11,400	10,100	9,310
Colombia		2,330	2,930	3,380	3,150
Germany		1,910	1,350	881	1,620
Italy		8,850	6,980	3,830	3,300
Japan		1,500	1,870	1,880	2,970
Mexico		12,400	8,680	10,200	8,150
Netherlands		19,400	13,700	19,200	12,000
United Kingdom		3,140	6,370	2,310	5,210
Other		6,370 r	8,720 r	6,200	11,700
Total		76,300	69,200	66,200	65,400
Ferrozirconium:	7202.99.1000				
Argentina		39	56	--	--
Costa Rica		79	104	2	3
Guatemala		120	158	80	108
Mexico		178	365	91	184
Nicaragua		--	--	39	54
United Kingdom		43	117	19	19
Other		31 r	54 r	28	45
Total		491	853	259	414
Unwrought zirconium, powders:	8109.20.0000				
France		15	606	13	769
Germany		6	247	6	327
Japan		9	384	7	250
Mexico		41	1,300	22	711
Russia		--	--	60	3,250
United Kingdom		111	1,930	105	2,040
Other		20 r	838 r	15	584
Total		202	5,310	228	7,930
Zirconium waste and scrap:	8109.30.0000				
Canada		36	1,920	26	1,480
France		6	69	13	203
Japan		9	177	15	345
Sweden		9	109	28	362
United Kingdom		9	315	11	273
Other		1 r	29 r	5	153
Total		69	2,620	99	2,820
Other zirconium:	8109.90.0000				
Canada		413	30,100	445	32,500
China		360	25,100	467	35,400
France		120	6,240	179	10,800
Japan		333	17,300	268	19,600
Korea, Republic of		162	19,200	184	21,400
Spain		70	9,000	73	9,680
United Kingdom		38	2,790	61	6,130
Other		111	8,000	155	11,700
Total		1,610	118,000	1,830	147,000

rRevised. -- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Harmonized Tariff Schedule of the United States.

Source: U.S. Census Bureau.

TABLE 4
U.S. IMPORTS FOR CONSUMPTION OF ZIRCONIUM AND HAFNIUM, BY CLASS AND COUNTRY[1]

Class and country	HTS[2]	2006 Quantity (metric tons)	2006 Value (thousands)	2007 Quantity (metric tons)	2007 Value (thousands)
Zirconium ore and concentrates:	2615.10.0000				
Australia		21,000	$15,200	8,320	$6,520
South Africa		13,900	10,700	10,400	7,650
Other		1,360	2,790	1,250	3,270
Total		36,200	28,600	20,000	17,400
Ferrozirconium:	7202.99.1000				
Brazil		187	490	400	1,070
Other		10	16	--	--
Total		197	506	400	1,070
Unwrought zirconium, powder:	8109.20.0000				
France		128	2,540	125	3,590
Germany		66	2,260	105	2,340
Other		20	186	33	270
Total		213	4,990	263	6,190
Zirconium waste and scrap:	8109.30.0000				
Canada		9	78	8	80
France		18	106	21	154
Japan		4	35	5	21
United Kingdom		11	84	--	--
Other		1 r	6	2	23
Total		43	309	36	278
Other zirconium:	8109.90.0000				
Belgium		23	411	24	704
Canada		67	4,160	39	2,740
France		352	34,500	351	40,000
Germany		20	5,330	40	7,420
Other		29	1,000	32	735
Total		492	45,400	485	52,300
Unwrought hafnium including powders:	8112.92.2000				
Australia		--	--	(3)	153
Canada		2	256	(3)	5
France		2	386	2	565
United Kingdom		(3)	9	1	141
Other		(3)	50 r	(3)	85
Total		4	701	4	951

rRevised. -- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Harmonized Tariff Schedule of the United States.
[3]Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 5
ZIRCONIUM MINERAL CONCENTRATES: ESTIMATED WORLD PRODUCTION, BY COUNTRY[1, 2]

(Metric tons)

Country[3]	2003	2004	2005	2006	2007
Australia	462,000 [4]	441,000 [4]	427,000 [4]	492,000 [r, 4]	605,000 [4]
Brazil[5]	27,198 [4]	25,263 [4]	25,657 [4]	26,512 [r, 4]	30,700
China	50,000	140,000	160,000	170,000	180,000
India	24,800 [r]	25,400 [r]	26,700 [r]	28,000 [r]	29,000
Indonesia	250	500 [r]	2,600 [r]	65,000 [r]	111,000
Malaysia	3,456 [4]	6,886 [4]	4,954 [4]	1,690 [r, 4]	2,000
Russia[6]	6,600	5,500	6,700	7,500	7,136 [4]
South Africa[7]	404,000	368,000	376,000	398,000	400,000
Ukraine	35,000	35,000	35,000	35,000	35,000
United States	W	W	W	W	W
Vietnam	23,000 [r]	39,400 [r]	32,500 [r]	26,100 [r]	25,000
Total[8]	1,040,000 [r]	1,090,000 [r]	1,100,000 [r]	1,250,000 [r]	1,420,000

[p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data; not included in total.
[1]World totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.
[2]Includes data available through May 9, 2008.
[3]Small amounts of zirconium concentrates were produced in various countries; however, information is not sufficent to estimate output.
[4]Reported figure.
[5]Includes production of baddeleyite-caldasite.
[6]Production of baddeleyite concentrate averaging 98% ZrO_2.
[7]Includes production of byproduct zircon from titanium sands mining from Palabora Mining Co. Ltd.
[8]Does not include U.S. data, which are withheld to avoid disclosing company proprietary data.