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2009 Minerals Yearbook

ZIRCONIUM AND HAFNIUM [ADVANCE RELEASE]

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Zirconium and Hafnium

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In 2009, global economic conditions continued to depress zircon consumption. In response to decreased demand, zircon producers curtailed production and delayed some expansion programs.

World production of zirconium mineral concentrates in 2009, excluding U.S. production, was about 1.16 million metric tons (Mt) compared with 1.28 Mt in 2008. The primary source of zirconium was the mineral zircon ($ZrSiO_4$) principally found in heavy-mineral sands. A relatively small quantity of zirconium was derived from the mineral baddeleyite, a natural form of zirconium oxide (ZrO_2) produced from a single source at Kovdor, Russia. In 2009, the leading producers of zircon were Australia and South Africa. Zircon is also the primary source of hafnium; zirconium and hafnium are contained in zircon at a ratio of about 50 to 1. The leading producers of zirconium and hafnium metal were France, Russia, and the United States.

Because of economic conditions, U.S. production of milled zircon decreased significantly compared with that of 2008. The United States remained a net exporter of zirconium ore and concentrates. U.S. exports of zirconium ore and concentrate decreased by 6%, and imports of zirconium ore and concentrates decreased by 58% compared with those of 2008. 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 a coproduct of the mining and processing of heavy-mineral sands for the titanium minerals ilmenite and rutile. In 2009, U.S. producers of zircon were DuPont Titanium Technologies (DuPont) (a subsidiary of E.I. du Pont de Nemours & Co.) 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.

Data for zirconium and hafnium manufactured materials were developed by the U.S. Geological Survey (USGS) from a voluntary survey of domestic operations. Of the 41 operations surveyed, 20 responded. Data for nonrespondents were estimated on the basis of prior-year levels adjusted for the effect of economic conditions. Domestic production of milled zircon was 38,400 metric tons (t). Domestic production of zircon concentrate in 2009 decreased compared with that of 2008. Insufficient data were available to determine stocks of zircon and zirconium oxide as well as production of zirconium oxide (table 1).

Data for zircon concentrates were developed from a second voluntary survey of domestic mining operations. The two domestic zircon producers responded. Data on domestic production and consumption of zircon concentrates were withheld to avoid disclosing company proprietary data.

Iluka commenced mining at its Brink deposit in Virginia 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 life of the Virginia operations to 2015. At Green Cove Springs, FL, Iluka ceased reprocessing of stockpiled tailings (Iluka Resources Ltd., 2010, p. 2, 44).

U.S. producers of zirconium and hafnium metal were ATI Wah Chang (an Allegheny Technologies, Inc. business unit) in Albany, OR, and Western Zirconium (a subsidiary of Westinghouse Electric Co.) in Ogden, UT. Milled zircon (flour) was produced from zircon sand by at least five companies, and zirconium chemicals were produced by about a dozen companies.

Wah Chang was increasing its zirconium sponge production and vacuum arc remelting (VAR) capacity at its Albany facility. The company cited anticipated growth in consumption in the chemical processing industry and nuclear energy industries as the motivation to increase capacity. In the nuclear industry, zirconium and hafnium alloys are used in nuclear fuel cladding and structural components (Allegheny Technologies Inc., 2010, p. 3). The additional capacity was expected to increase domestic zirconium sponge capacity to about 5,800 metric tons per year (t/yr).

Westinghouse Electric Co. formed an agreement with the State Nuclear Power Technology Co., Ltd. (SNPT) to construct a nuclear-grade zirconium sponge plant at Nantong, Jiangsu Province, China. The plant was expected to supply nuclear-grade sponge to Westinghouse's Western Zirconium Plant in Ogden and the market in China. SNPT expected to produce up to 1,000 t/yr of nuclear sponge within 3 years (World Nuclear News, 2009).

Industrial Minerals Corp. (IMC) received a mining permit from Oregon Department of Geology and Mineral Industries for its Coos Bay, OR, heavy-minerals project. Once financing is secured, IMC expected to begin producing chromite, garnet, and zircon within a year. Estimated proven ore reserves at Coos Bay were 7.9 Mt with a heavy-mineral grade of 21.5% and zircon grade of 0.4% (Industrial Minerals Corp. Ltd., 2009, p. 4, 12).

Consumption

Major end uses of zircon were ceramics, zirconia and zirconium chemicals, and foundry and refractories. Global consumption of zircon was estimated to be 0.99 Mt in 2009, significantly less than the estimated 1.3 Mt consumed in 2008 (Mineral Sands Report, 2010b). According to a leading zircon producer, the leading end uses for zircon in 2008 were ceramics (54%), zirconia and chemicals (15%), refractory (14%), and foundry and casting (14%) (Porter, 2010, p. 8). Zircon is also used as a natural gemstone and may be processed to produce cubic zirconia, a synthetic gemstone and diamond simulant.

Zirconium metal is used in corrosive environments, nuclear fuel cladding, and various specialty alloys. The principal uses of hafnium were in high-temperature ceramics, nickel-base superalloys, nozzles for plasma arc metal cutting, and nuclear control rods.

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) was used in the manufacture of oxygen sensors that control combustion in automobile engines and furnaces. YSZ was also used in the manufacture of a diverse array of products, including cubic zirconia, fiber optic connector components, refractory coatings, and structural ceramics. YSZ was used in dental applications, such as bridges, crowns, and inlays, because 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 was used in refractory paints for coating the surfaces of molds. In the form of refractory bricks and blocks, zircon was 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 were used as paper and board coatings or insolubilizers for high-quality print performance. Zirconium chemicals were 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 rod tubes. Hafnium is used in nuclear control rods because of its high thermal neutron absorption cross section. Commercial-grade zirconium, unlike nuclear grade, contains hafnium and was used in the chemical process industries because of its excellent corrosion resistance. Hafnium metal also is used as an alloy addition in superalloys. The French zirconium metal producer Cezus (a subsidiary of Areva NP) estimated the global zirconium metal consumption to be about 5,000 t (Desai, 2009a).

Prices

Despite a significant reduction in consumption, prices of zirconium ores and concentrates increased in 2009. At yearend, the published price range of standard grade, bulk, free-on-board, Australian zircon was $880 to $900 per metric ton, up from $725 to $800 per ton at yearend 2008 (table 2). The unit value of imports also increased. Although the import volume decreased by 58%, the average unit value of imported zirconium ore and concentrates was $1,190 per ton in 2009, a 35% increase from that in 2008. Increased prices appeared to indicate a recovery in demand in the second half of the year.

No published prices were available for zirconium metal. In 2009, the average unit value of imported unwrought zirconium including sponge and powder from France was $51.50 per kilogram, a 27% increase from that in 2008. The average unit value of imported unwrought hafnium including sponge and powder from France was $472 per kilogram, a 110% increase from that in 2008.

Foreign Trade

In 2009, Australia (56%) and South Africa (35%) supplied most of the imports of ores and concentrates, and the United States remained a net exporter of zirconium ore and concentrates (table 4). Net exports of zirconium ore and concentrates increased significantly, reflecting the sharp decrease in domestic consumption (table 3). The majority of zirconium metal was exported in wrought products classified as “Other zirconium” in the Harmonized Tariff Schedule category 8109.90.0000. Because of weak economic conditions, imports of zirconium and hafnium metal were less than 1,000 t. Imports of zirconium and hafnium metal decreased by 5% and 58%, respectively, compared with those of 2008. Imports of germanium and zirconium oxides decreased significantly, with China (50%) as the leading import source of oxides. Because of weakening demand in the steel industry, domestic imports of ferrozirconium alloys plummeted to 0.249 t in 2009 from the 129 t imported in 2008. In 2008 and 2009, all ferrozirconium imports originated from Brazil.

World Review

Excluding U.S. production, world production of zirconium mineral concentrates in 2009 was about 1.16 Mt, a 9% decrease compared with revised 2008 data (table 5). Australia and South Africa supplied about 75% of all production outside the United States. China was the leading consumer. Based on metal oxide content, world reserves of zirconium and hafnium were estimated to be 56 Mt and 660,000 t, respectively. In 2009, several producers idled or curtailed mine production. Exploration and development continued but several projects were postponed. Major zircon producers were Iluka, Richards Bay Minerals (BHP Billiton plc/Rio Tinto plc), Exxaro Resources Ltd., The National Titanium Dioxide Co. Ltd. (Cristal Global), and DuPont.

Australia.—Iluka began production of zircon at its Jacinth-Ambrosia Mine in the Eucla Basin, South Australia. During its mine life of more than 10 years, Jacinth-Ambrosia was expected to produce approximately 2.8 Mt of zircon, 350,000 t of rutile, and 1.5 Mt of ilmenite (Iluka Resources Inc., 2009b). In Western Australia, Iluka idled its Eneabba Mine because of declining ore grades and the opening of the Jacinth-Ambosia Mine. In 2009, Iluka was in the process of upgrading the Narngulu mineral separation plant to process heavy-mineral concentrate from the Jacinth-Ambrosia concentration plant (Iluka Resources Inc., 2009a).

The Australian Nuclear Science and Technology Organization’s Minerals Business Unit produced sample quantities of zirconium chemicals from ore extracted from Alkane Resources Ltd.’s zircon-rich mineral deposit near Dubbo, New South Wales. In 2009, Alkane Resources was refining its designs to recover niobium-tantalum, rare earth, and zirconium chemicals and concentrates (Alkane Resources Ltd., 2009, p. 11).

The Australian Government approved Astron Ltd.’s environmental plan for the development of its Donald heavy-minerals deposit in the Murray Basin, Victoria. Astron planned to produce heavy-mineral concentrate from Donald and then process the concentrate through a mineral sand separation plant in China (Astron Ltd., 2009, p. 6). According to Astron, the deposit contained an indicated and inferred resource of ilmenite (8.5 Mt), leucoxene (5.4 Mt), zircon (5.2 Mt), and rutile (1.2 Mt) (Astron Ltd., undated).

Australian Zircon NL's suspended mining activities at its Mindarie operation in South Australia, and the company went into administration to obtain relief from its creditors. During 2009, the company continued a feasibility study of the WIM150 deposit and produced ilmenite, rutile, and zircon from previously mined ore through yearend (Mineral Sands Report, 2009a). Although no data were available for 2009, in 2008, the Mindari operation produced about 6,000 t of zircon (Geoscience Australia, 2009, p. 48).

Mintech Chemical Industries Pty. Ltd. acquired Doral Specialty Chemicals Pty. Ltd. (DSC) from the Doral Group. DSC's assets included zircon-based pigments mixing and zircon milling capacity as well as a zirconium chemicals operation in Kwinana, Western Australia, which was idle since 2008. Doral retained ownership of its heavy-mineral mining operations near Picton, Western Australia, and fused zirconia and alumina operations in Rockingham, Western Australia (Industrial Minerals, 2009).

In May, Unimin Australia Ltd. acquired Consolidated Rutile Ltd. (CRL) from Iluka. In 2009, the CRL Mine on North Stradbroke Island, Queensland, was estimated to contain 3.2 Mt of heavy-minerals with a heavy-mineral suite containing ilmenite, rutile, and zircon (Mineral Sands Report, 2009c).

Gunson Resources Ltd. completed a feasibility study for its Coburn heavy-minerals project in Western Australia. The project was ready to proceed to the mine development stage and was expected to have a life of 23.5 years. Most of the revenue from the proposed mine was expected to be from zircon production (Mineral Sands Report, 2010a).

Matilda Zircon Ltd. was developing zircon-rich heavy-minerals deposits in the Tiwi Islands, Northern Territory. In 2009, the Tiwi Islands operation included a 150-metric-ton-per-hour concentration plant but did not include a separation plant. A new mine at the Lethbridge deposit, Melville Island, was expected to be in production by mid-2010. Although no production data were available for 2009, in 2008, the Tiwi Islands operation produced 46,000 t of heavy-mineral concentrate grading 50% zircon that was shipped to China (Matilda Zircon Ltd., 2009a, b).

Canada.—Sustainable Development Technology Canada awarded Titanium Corp.'s "Creating value from waste" project $4.9 million in funding. The award was expected to promote technologies that recover bitumen and heavy minerals including zircon from oil sands tailings. Consortium members of the project included Sojitz Corp., Syncrude Canada Ltd., Titanium Corp., and the Government of Alberta (Titanium Corp., 2009).

China.—As a leading producer of ceramic tiles, steel, and zirconium chemicals, China was estimated to consume about 40% of the total global zircon consumed. Zircon consumption growth in China from 1990 to 2008 was estimated to be 17.2%, and tile production primarily supported domestic uses (Porter, 2010, p. 7).

In 2009, zirconium chemical production capacity in China was estimated to be 200,000 t/yr, and about 90% of production was in the form of zirconium oxychloride (Mineral Sands Report, 2009b).

Hainan Taixin Minerals Co. Ltd. acquired mining rights to a heavy-mineral deposit near Wanning City, Hainan Province. The deposit was reported to have a proven reserve of zircon (0.5 Mt) and ilmenite (2.24 Mt). While granting the mining rights, the Provincial government stipulated that the company would be required to produce added-value products beyond ilmenite and zircon concentrates (Mineral Sands Report, 2009d).

India.—India's Department of Atomic Energy commissioned zirconium oxide and zirconium sponge capacity at its zirconium complex in Pazhayakayal, Tamil Nadu. About 500 t/yr of zirconium oxide capacity via solvent extraction and 250 t/yr of zirconium sponge capacity via Kroll reduction were being added primarily for use in nuclear applications. The expansion was expected to raise India's total zirconium sponge capacity to 650 t/yr from 400 t/yr (Indian Department of Atomic Energy, 2010, p. 4).

Indonesia.—In September, Matilda Zircon entered into a memorandum of understanding with PT Makmur Santosa Energi to develop zircon-rich areas in Kalimantan. Pending the results of a due diligence study, Matilda Zircon planned to relocate its heavy-mineral concentration plant from Sampit to central Kalimantan. The Sampit concentration plant was reported to have a capacity of 7,000 t/yr of heavy-mineral concentrate containing about 64% zircon. Once relocated, the plant was expected to produce up to 12,000 t/yr of heavy-mineral concentrate (Matilda Zircon Ltd., 2009a).

Kenya.—In August, the Jinchuan Group Ltd. entered into an understanding with Tiomin Resources Inc. wherein Jinchuan was to acquire 70% of Tiomin Kenya Ltd. (TKL) mineral sands project; however, in October, Jinchuan terminated the agreement. At yearend, Tiomin abandoned plans to develop the deposit and wrote off all the costs associated with the Kwale project. Subsequent to yearend, Tiomin changed its name to Vaaldiam Mining Inc. (Vaaldiam Mining Inc., 2010).

Mozambique.—BHP Billiton completed a prefeasibility study of the Corridor Sands heavy-minerals project. BHP concluded that the results of the study did not warrant further development of the project (BHP Billiton Ltd., 2009, p. 33). The Corridor Sands project was based upon 10 deposits near Chibuto in southern Mozambique. Previously, total resources of ore were estimated to be 14 billion metric tons, with the largest deposit containing about 300 Mt of ilmenite.

Russia.—ARMZ Uranium Holding Co. was developing the Lukoyanovskoye heavy-minerals sands deposit near Nizhny Novgorod. ARMZ planned to commission a mine and processing plant with the annual capacity to process up to 1.5 billion metric tons per year of ore sands by 2014. According to the Russian classification system, ore reserves in categories "C1" and "C2" were estimated to be 30 Mt containing about 1 Mt of titanium in the form of ilmenite, leucoxene, and rutile and more than 350,000 t of zirconium oxide in the form of zircon. ARMZ planned to supply mineral concentrates to OJSC TVEL (ARMZ Uranium Holding Co., 2009).

Senegal.—A feasibility study of Mineral Deposits Ltd.'s Grande Cote deposit was underway in 2009. The study was expected to be completed in 2010 and was to include updated capital costs, circuit model test work, financial modeling, geological block modeling, hydrological modeling, and mine path design (Mineral Deposits Ltd., 2010b). The company planned to produce up to 75,000 t/yr of zircon and 600 t/yr of ilmenite for mine life of more than 25 years (Mineral Deposits Ltd., 2010a).

South Africa.—In April, Foskor Zirconia Pty. Ltd. temporarily suspended its fused zirconia operations because of weak demand from the steel industry; however, by May, the operation was restarted with a more diverse product line directed toward wear applications and the glass industry. In 2008, Foskor Zirconia was acquired by Carborundum Universal Ltd. and increased its production capacity to 4,500 t/yr from 3,750 t/yr of calcia-stabilised and monoclinic zirconia (Mining Weekly, 2009).

Vietnam.—In an effort to assist the domestic mining industry, the Government of Vietnam temporarily lifted a ban on exports of titanium and zirconium mineral concentrates. Producers were permitted to export from mid-2009 through the end of 2010. The ban had been imposed to encourage the production of value-added products. In 2008, the export tariff for zircon ore was raised to 20% from 15% (Mineral Sands Report, 2009e).

Outlook

Growth in the consumption of zirconium mineral concentrates was expected to increase with demand from consumers such as the ceramics, metals, and chemicals industries. Because the use of these materials is pervasive in the global economy, economic growth may be used to reflect trends in zirconium consumption. The International Monetary Fund projected that world economic growth would be about 4.5% in 2010 and 4.25% in 2011. China was expected to lead global economic growth with 10.5% in 2010 and 9.6% growth expected in 2011. The U.S. economy was projected to increase by 3.3% in 2010 and 2.9% in 2011 (International Monetary Fund, 2010). Over the longer term, the Bureau of Labor Statistics projected the U.S. gross domestic product to average 2.4% growth annually from 2008 to 2018 (Wyatt and Byun, 2009).

Since 2007, several new mines were bought online in Australia, Mozambique, and South Africa ensuring adequate global supply for several years. However, beyond 2013, new mine capacity may be required to meet increased consumption. The stockpiling and destocking of mineral concentrates by consumers, producers, and distributors will continue to influence the price and short-term availability of supply.

Global demand for nuclear powerplants was expected to increase future demand for zirconium and hafnium metal. According to the World Nuclear Association, on a global basis, 47 nuclear powerplants were under construction in June 2009, and another 133 were planned. Although the amount of zirconium metal varies, boiling water reactors were estimated to contain on average about 44 t of zirconium, and pressurized heavy-water reactors require about 12.5 t. Zirconium metal consumption was projected to reach 6,500 t by 2015, a small fraction of the global consumption of zirconium mineral concentrates (Desai, 2009b).

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

(Metric tons)

	2005	2006	2007	2008	2009
Zircon:					
Production:					
Concentrates	W	W	W	W	W
Milled zircon	46,300	50,800	64,600	61,500	38,400
Exports	101,000	76,300	66,200	42,100	39,600
Imports for consumptions[2]	38,200	36,200	20,000	34,400	14,400
Consumption, apparent[3]	W	W	W	W	W
Stocks, December 31, dealers and consumers[4]	16,100	17,600	18,000	26,600	NA
Zirconium oxide:					
Production[5]	19,900	21,700	25,600	18,100	NA
Exports[6]	2,260	3,340	2,400	2,970	3,050
Imports for consumptions[6]	3,160	2,820	3,740	5,060	2,810
Consumption, apparent[3]	21,000	24,200	26,900	20,400	17,300 [7]
Stocks, December 31, producers[4]	2,210	1,560	1,880	1,670	NA
Zirconium; unwrought powder, waste and scrap, other:					
Exports	1,970	1,880	2,160	2,670	2,300
Imports	1,020	748	784	1,030	977
Ferrozirconium:					
Exports	65	491	259	316	566
Imports	306	196	400	129	(8)
Hafnium, unwrought powder, waste and scrap, other, imports	4	4	4	12	5

NA Not available. 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.
[7]Excludes changes in inventories.
[8]Less than ½ unit.

TABLE 2
PUBLISHED YEAREND PRICES OF ZIRCONIUM MATERIALS

(Dollars per metric ton)

Material	2008	2009
Baddeleyite, contract price, cost, insurance, and freight main European port:		
Refractories/abrasive grade	2,500-3,100	2,500-3,100
Ceramic grade (98% zirconium oxide and hafnium oxide)	3,000-3,300	3,000-3,300
Zircon:		
Domestic, standard-grade, bulk	775-800	800-860
Australian, standard-grade, free on board, bulk	725-820	880-900
Zirconia, fused, monoclinic, refractory/abrasive	NA	4,100-4,900

NA Not available.

Source: Industrial Minerals.

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

Class and country	HTS[2]	2008 Quantity (metric tons)	2008 Value (thousands)	2009 Quantity (metric tons)	2009 Value (thousands)
Ore and concentrates:	2615.10.0000				
Belgium		2,530	$2,940	6,580	$6,850
Brazil		2,920	4,070	188	186
Canada		2,560	2,700	1,770	2,090
Colombia		1,550	2,000	697	909
Germany		2,090	2,980	870	1,240
Italy		355	395	156	232
Japan		2,040	4,060	11,600	6,520
Korea, Republic of		1,090	3,130	2,320	2,060
Mexico		9,860	7,000	4,010	4,140
Netherlands		11,200	9,590	9	53
United Kingdom		2,070	4,870	1,540	2,470
Other		3,840 r	7,420	9,830	9,590
Total		42,100 r	51,100	39,600	36,300
Ferrozirconium:	7202.99.1000				
Canada		72	167	54	122
Costa Rica		41	51	20	25
Guatemala		19	25	--	--
Mexico		128	253	490	983
Nicaragua		39	52	--	--
Other		16	27	1	10
Total		316	574	566	1,140
Unwrought zirconium, powders:	8109.20.0000				
France		16	1,020	37	1,730
Germany		11	347	11	356
Japan		12	501	6	347
Mexico		5	214	--	12
Russia		49	2,740	73	4,000
United Kingdom		211	4,190	24	730
Other		40	1,420	14	484
Total		344	10,400	165	7,660

See footnotes at end of table.

TABLE 3—Continued

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

Class and country	HTS[2]	2008 Quantity (metric tons)	2008 Value (thousands)	2009 Quantity (metric tons)	2009 Value (thousands)
Zirconium waste and scrap:	8109.30.0000				
Canada		49	2,790	27	1,590
France		13	171	12	208
Germany		36	581	--	--
Japan		29	783	--	--
Netherlands		44	507	--	--
Sweden		35	618	16	266
United Kingdom		27	705	--	--
Other		13	561 r	3	42
Total		247	6,720 r	58	2,110
Other zirconium:	8109.90.0000				
Canada		446	32,500	442	37,200
China		698	60,000	680	62,700
France		129	8,720	149	11,600
Japan		316	22,200	205	17,500
Korea, Republic of		136	15,700	287	26,100
Spain		92	13,600	83	14,300
Sweden		95	7,510	109	9,280
Other		167	13,100	122	11,100
Total		2,080	173,000	2,080	190,000

[r]Revised. -- 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]	2008 Quantity (metric tons)	2008 Value (thousands)	2009 Quantity (metric tons)	2009 Value (thousands)
Zirconium ore and concentrates:	2615.10.0000				
Australia		12,700	$9,530	8,090	$6,910
South Africa		19,600	14,900	5,080	7,390
Other		2,010	5,790	1,250	2,810
Total		34,400	30,200	14,400	17,100
Ferrozirconium, Brazil	7202.99.1000	129	594	(3)	7
Unwrought zirconium, powder:	8109.20.0000				
France		8	332	3	166
Germany		66	2,330	9	1,540
Other		20	121	9	190
Total		94	2,790	22	1,890
Zirconium waste and scrap:	8109.30.0000				
Australia		88	103	18	22
Canada		7	54	--	--
France		49	674	83	807
Japan		70	69	1	16
Other		11	141	327	1,050
Total		224	1,040	429	1,900

See footnotes at end of table.

TABLE 4

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

		2008		2009	
Class and country	HTS[2]	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Other zirconium:	8109.90.0000				
Belgium		21	708	20	467
Canada		40	4,400	34	3,810
France		335	39,800	347	48,600
Germany		40	11,300	7	2,210
South Africa		240	280	86	112
Other		39	1,690	33	1,330
Total		715	58,200	526	56,500
Unwrought hafnium including powders:	8112.92.2000				
France		6	1,410	4	1,910
Germany		5	1,770	--	23
United Kingdom		1	564	--	--
Other		(3)	111	1	153
Total		12	3,850	5	2,080

-- 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]	2005	2006	2007	2008	2009
Australia	427,000 [4]	492,000 [4]	601,000 [4]	550,000 [4]	476,000 [4]
Brazil[5]	25,657 [4]	25,120 [4]	26,739 [4]	17,682 [r, 4]	18,134 [4]
China	120,000	135,000	140,000	140,000	130,000
India	26,700 [4]	28,000	29,000	30,000	31,000
Indonesia	2,600	65,000	111,000	65,000	63,000
Malaysia	4,954 [4]	1,690 [4]	7,393 [4]	7,000	7,000
Russia[6]	6,700	7,500	7,136 [4]	7,000 [4]	5,000 [4]
South Africa	376,000	398,000	400,000	400,000	392,000
Ukraine	35,000	35,000	35,000	35,000	35,000
United States	W	W	W	W	W
Vietnam	32,500	26,100	22,000	22,000	7,000
Total[7]	1,060,000	1,210,000	1,380,000	1,270,000 [r]	1,160,000

[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 April 30, 2010.

[3]Small amounts of zirconium concentrates were produced in various countries; however, information is not sufficient to estimate output.

[4]Reported figure.

[5]Includes production of baddeleyite-caldasite.

[6]Production of baddeleyite concentrate averaging 98% ZrO_2.

[7]Does not include U.S. data, which are withheld to avoid disclosing company proprietary data.