



# 2014 Minerals Yearbook

---

## ZIRCONIUM AND HAFNIUM [ADVANCE RELEASE]

---

# ZIRCONIUM AND HAFNIUM

By George M. Bedinger

**Domestic survey data and tables were prepared by Mahbood Mahdavi, statistical assistant, and the world production table was prepared by Glenn J. Wallace, international data coordinator.**

In 2014, production of zirconium ore and concentrates in the United States decreased and production of milled zircon decreased by 10% from that of 2013. World production of zirconium mineral concentrates in 2014, excluding U.S. production, was about 1.45 million metric tons (Mt), a 36% increase over revised 2013 production totals.

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 form of zirconium oxide ( $ZrO_2$ ) recovered from a single source in Kovdor, Russia. In 2014, the leading producers of zircon were Australia and South Africa. Zircon was 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 (TZ Minerals International Pty Ltd., 2014, p. 45).

In 2014, the United States was a net importer of zirconium ore and concentrates. Exports of zirconium concentrates decreased by 74%, whereas imports tripled in 2014 compared with those in 2013 owing to the decrease in domestic production of zirconium concentrates.

## Production

Zircon is a coproduct of the mining and processing of heavy-mineral sands for the titanium minerals ilmenite and rutile. In 2014, the U.S. producers of zircon were DuPont Titanium Technologies (DuPont) (a subsidiary of E.I. du Pont de Nemours and Co., Wilmington, DE) and Iluka Resources, Inc. (a wholly owned subsidiary of the Australian company Iluka Resources Ltd., Perth, Western Australia, Australia). DuPont produced zircon from its operation near Starke, FL, and Iluka produced zircon from its operations near Stony Creek, VA. Iluka announced that it expected to cease mining and processing activities in the United States at the end of 2015 following reserve depletion at the Brink and Concord deposits in Virginia. Iluka continued to hold mineral leases of resources located near Aurelian Springs, NC, and Hickory, VA (Iluka Resources Ltd., 2014).

Southern Ionics Inc. was developing heavy-mineral deposits at its Mission North and Mission South Mines in Brantley County and Charlton County, GA, respectively. Operations at the Mission South Mine commenced in May 2014. Heavy-mineral concentrates extracted from Mission South were stockpiled until construction of the Offerman mineral separation plant (MSP), was completed in May 2015. The Offerman MSP was to process heavy-mineral concentrates from Mission South and the Mission North Mines, which were expected to begin operations in late 2015. Production in 2015 was

expected to be 14,700 metric tons per year (t/yr) of zircon (Southern Ionics Inc., 2013, p. 26; 2014; 2015).

Twin Pines Minerals LLC was developing a project to produce zircon and ilmenite concentrates by reprocessing tailings from former sand operations in New Jersey. A mineral sands wet concentration plant was being constructed with a capacity of 232 metric tons per hour with production expected to begin in the third quarter of 2015 (Mineral Sands Report, 2014, p. 5; Patel, 2015).

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.

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

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 30 operations surveyed, 8 responded. Data for nonrespondents were estimated on the basis of prior-year levels adjusted for the effect of economic conditions. Estimated domestic production of milled zircon was 43,300 metric tons (t) (table 1).

## Consumption

Globally, the leading end uses for zircon were ceramics, zirconia, zirconium-based chemicals, refractories, and foundry and casting applications. Zircon sand is preferred in applications where high-quality finishes and tight tolerances are required owing to its lower expansion coefficient and greater stability at high temperatures compared with other materials. Zircon was also used as a natural gemstone and may be processed to produce cubic zirconia, a synthetic gemstone and diamond simulant.

Zirconium oxide exhibits high light reflectivity and good thermal stability and was primarily used as an opacifier and pigment in glazes and colors used 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 engineering 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. Refractory bricks and blocks containing zircon were used in furnaces and hearths for containing molten metals.

Baddeleyite was used principally in the manufacture of alumina-zirconia abrasives 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.

Zirconium metal was 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. Because of its low thermal neutron absorption cross section, hafnium-free zirconium metal was used as cladding for nuclear fuel rod tubes. Hafnium was 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 chemical process industries because of its excellent corrosion resistance. Hafnium metal also was used as an addition in superalloys.

## Prices

The 2014 yearend published price range of standard-grade bulk domestic zircon concentrate was \$950 to \$1,150 per metric ton, unchanged from yearend prices of 2013 (table 2). According to U.S. Census Bureau data, the average unit value of imported zirconium ore and concentrates in 2014 was \$1,207 per metric ton, a 4% decrease from those of 2013 (table 4).

No published prices were available for zirconium or hafnium metal. In 2014, the average duty-paid unit value of imported unwrought zirconium (including sponge and powder) from China, the major source of imports, was \$59 per kilogram, a 22% decrease from that in 2013. The average duty-paid unit value of imported unwrought hafnium (including sponge and powder) from France was \$565 per kilogram, a 2% decrease from that in 2013.

## Foreign Trade

In 2014, exports of zirconium ore and concentrates decreased by 74% owing to decreased domestic production. Most zirconium metal was exported in wrought products classified as "Other zirconium" under the Harmonized Tariff Schedule of the United States (HTS) code 8109.90.0000 (table 3).

Imports of zirconium metal, HTS code 8109, totaled 1,098 t in 2014, a 53% increase from revised totals of 2013. Imports of hafnium metal, HTS code 8112, totaled 21 t, an increase of 110% from that of 2013. South Africa and Australia supplied most of the zirconium ores and concentrates (60% and 36%, respectively) imported into the United States (table 4).

Imports of germanium and zirconium oxides, HTS code 2825, increased by 33%; China (49%), France (25%), and the United Kingdom (15%) were the leading import sources of oxides. Domestic imports of ferrozirconium alloys increased to 131 t in 2014 from 4 t in 2013.

## World Review

Excluding U.S. production, world production of zirconium mineral concentrates in 2014 was about 1.45 Mt, a 36% increase compared with revised 2013 production data because prices, which decreased significantly during 2013, stabilized and as mineral sands producers replenished inventories (table 5). Australia and South Africa supplied about 66% of all production outside the United States.

**Australia.**—Iluka produced 333,000 t of zircon from its operations in Australia, an increase of 35% compared with that of 2013. Production was 240,000 t from its operations in the Eucla Basin, South Australia, and the Perth Basin, Western Australia, and 93,000 t from its operations in the Murray Basin, Victoria (Iluka Resources Ltd., 2015, p. 18).

MZI Resources Ltd. continued to develop the Keysbrook project in Western Australia and expected to begin production in the fourth quarter of 2015. Production of zircon was expected to be 56,000 t/yr during a 15-year mine life (MZI Resources Ltd., 2015a; 2015b, p. 5).

Image Resources NL was developing its Atlas and Boonanarring Mines in the Perth Basin. The mines were expected to produce 32,400 t/yr of zircon during a 10-year mine life. Production was scheduled to begin in late 2016 (Image Resources NL, 2014; 2015, p. 10).

**China.**—China imported 816,039 t of zircon concentrates in 2014, a decrease of 4% from that of 2013. The leading import sources, Australia and South Africa, accounted for 51% and 24%, respectively, of total imports (Metal-Pages, 2015).

At yearend 2014, China's production of ceramic tiles increased to a total capacity of 45.0 million square meters per day, an increase in capacity of 29% from that of 2011 (Mineral Sands Report, 2015, p. 25).

**Kenya.**—In February, Base Resources Ltd. began producing zircon concentrates from its Kwale heavy-mineral sands project and by yearend had produced 15,000 t of concentrates. During a mine life of 13 years, Base Resources expected to produce 30,000 t/yr of zircon (Base Resources Ltd., 2014, p. 7; 2015, p. 5).

**Madagascar.**—World Titanium Resources Ltd. (WTR) estimated ore reserves at its Ranobe deposit in the Toliara Sands Project in southwest Madagascar to be 161 Mt containing 8.2% heavy minerals. WTR expected to produce 44,000 t/yr of zircon-rutile concentrate during a mine life of 21 years. No timetable was given for start of production (World Titanium Resources, 2014, p. 8, 17).

**Mozambique.**—Kenmare Resources plc's production of zircon at its Moma Mine in 2014 was 50,800 t, an increase of 62% from that of 2013 (Kenmare Resources plc, 2015, p. 2, 33).

**Senegal.**—In the third quarter, Mineral Deposits Ltd. began processing zircon from its heavy-mineral concentrates at its Grand Côte Mine and by yearend, had produced 9,040 t of zircon. Grand Côte was expected to produce 85,000 t/yr of zircon during a 25-year mine life (Mineral Deposits Ltd., 2015, p. 4, 6).

**South Africa.**—Tronox Ltd. was proceeding with construction at its Fairbreeze Mine and expected to begin production in late 2015. During a 12-year mine life, the Fairbreeze Mine was expected to produce 60,000 t/yr of zircon (Casey, 2013, p. 8; Tronox Ltd., 2015, p. 2, 8).

Mineral Commodities Ltd. began production at the Tormin Mine on the west coast of South Africa in January and by yearend had produced 42,668 t of nonmagnetic zircon-rutile concentrate. The Tormin Mine was expected to produce 45,000 to 50,000 t/yr of zircon-rutile concentrate grading up to 81% zircon during an initial 3- to 5-year mine life (Mineral Commodities Ltd., 2015a, p. 7; 2015b).

## Outlook

China was the largest consumer of zircon and zircon-based products. Companies in China are expected to continue to acquire mining and access rights outside of China in order to secure zircon supplies. In January 2014, Mineral Commodities made its first shipment of zircon-rutile concentrate from its Tormin Mine to Wogen Pacific for consumption in China (Mineral Commodities Ltd., 2014).

In June 2015, Image Resources signed a nonbinding Memorandum of Understanding (MOU) with Murray Zircon Pty Ltd (Adelaide, South Australia, Australia) and its parent company, Guangdong Orient Zircon Ind Sci & Tech Co (OZC) (Chenghai, China). The MOU is expected to facilitate the development of the Boonanarring and Atlas mineral sands deposits. Purchase agreements of zircon by OZC were also specified by the MOU. The Atlas and Boonanarring Mines in the Perth Basin are expected to produce 32,400 t/yr of zircon during a 10-year mine life (Image Resources NL, 2014; 2015, p. 5).

Rio Tinto plc, a major producer of zircon concentrates in South Africa, projected overall zircon consumption to increase by about 4% per year until 2020 (Rio Tinto plc, 2014, p. 34). TZ Minerals International Pty Ltd. expected increased zircon demand would be led by the zirconium chemicals sector in 2015 with more than a 9% increase in consumption (TZ Minerals International Pty Ltd., 2014, p. 90).

## References Cited

- Base Resources Ltd., 2014, Annual report 2014: West Perth, Western Australia, Australia, Base Resources Ltd., 85 p. (Accessed April 14, 2015, at [http://www.baseresources.com.au/wp-content/files/Annual\\_Report\\_2014.pdf](http://www.baseresources.com.au/wp-content/files/Annual_Report_2014.pdf).)
- Base Resources Ltd., 2015, Interim financial report for the six month period ended 31 December 2014: West Perth, Western Australia, Australia, Base Resources Ltd., 22 p. (Accessed April 14, 2015, at [http://www.baseresources.com.au/wp-content/files/Half\\_Yearly\\_Report\\_and\\_Accounts\\_-\\_31\\_December\\_2014.pdf](http://www.baseresources.com.au/wp-content/files/Half_Yearly_Report_and_Accounts_-_31_December_2014.pdf).)
- Casey, Thomas, 2013, Ensuring opportunity and growth in the TiO<sub>2</sub> sector: Stamford, CT, Tronox Ltd., presentation to TZMI Congress 2013, 15 p. (Accessed October 28, 2015, at <http://files.shareholder.com/downloads/TRX/3741311709x0x707266/7ECAC99A-2837-4675-947B-0E32F746A9AA/Tom%20Casey%20-%202013%20TZMI%20Final%20Version.pdf>.)
- Iluka Resources Ltd., 2014, Yearend accounting (non-cash) adjustment: Perth, Western Australia, Australia, Iluka Resources Ltd., ASX release, 1 p. (Accessed June 23, 2015, at <http://iluka.com/docs/default-source/asx-releases/141212---asx-iluka-year-end-accounting-adjustment->)
- Iluka Resources Ltd., 2015, Annual report 2014: Perth, Western Australia, Australia, Iluka Resources Ltd., 169 p. (Accessed June 12, 2015, at <http://www.iluka.com/docs/default-source/annual-reports/iluka-annual-report-2014>.)
- Image Resources NL, 2014, Boonanarring and Atlas development project: Balcatta, Western Australia, Australia, Image Resources NL. (Accessed June 15, 2015, at <http://www.imageres.com.au/index.php/projects/boonanarring-and-atlas-development-project.html>.)
- Image Resources NL, 2015, Corporate update and presentation: Balcatta, Western Australia, Australia, Image Resources NL, 24 p. (Accessed June 15, 2015, at <http://www.imageres.com.au/images/joomd/143130714120150511ImageResourcesPresentationMay15.pdf>.)
- Kenmare Resources plc, 2015, 2014 annual report and accounts: Dublin, Ireland, Kenmare Resources plc, 44 p. (Accessed June 15, 2015, at <http://www.kenmareresources.com/~media/Files/K/Kenmare-Resources-PLC/pdf/interim-report/kenmare-resources-plc-2014-annual-report-accounts.pdf>.)
- Metal-Pages, 2015, Zircon sand and concentrate China imports down 4.05% in 2014: Metal-Pages, February 4. (Accessed June 11, 2015, via <http://www.metal-pages.com/>.)
- Mineral Commodities Ltd., 2014, First shipments of ultra-high-grade zircon rutile from Tormin, South Africa: Welshpool, Western Australia, Australia, Mineral Commodities Ltd. (Accessed December 23, 2015, at <http://www.mineralcommodities.com/wp-content/uploads/2014/01/MRC-First-Shipments-of-Ultra-High-Grade-Zircon-Rutile-at-Tormin.pdf>.)
- Mineral Commodities Ltd., 2015a, Annual report 2014: Welshpool, Western Australia, Australia, Mineral Commodities Ltd., 66 p. (Accessed December 23, 2015, at [http://www.mineralcommodities.com/wp-content/uploads/2015/04/LNK508\\_Mineral-Commodities\\_AR\\_v4\\_Final.pdf](http://www.mineralcommodities.com/wp-content/uploads/2015/04/LNK508_Mineral-Commodities_AR_v4_Final.pdf).)
- Mineral Commodities Ltd., 2015b, Projects—Tormin mineral sands: Welshpool, Western Australia, Australia, Mineral Commodities Ltd. (Accessed April 14, 2015, at <http://www.mineralcommodities.com/projects/tormin-mineral-sands/>.)
- Mineral Deposits Ltd., 2015, Annual report 2014: Melbourne, Victoria, Australia, Mineral Deposits Ltd., 76 p. (Accessed April 14, 2015, at <http://www.mineraldeposits.com.au/wp-content/uploads/2015/02/MDL-Annual-Report-2014.pdf>.)
- Mineral Sands Report, 2014, Twin Pines Minerals appoints Wogen Pacific: Mineral Sands Report, no. 229, November, 37 p.
- Mineral Sands Report, 2015, Ceramic tile performance in 2014: Mineral Sands Report, no. 232, February, p. 25.
- MZI Resources Ltd., 2015a, Keysbrook project 74% complete: Subiaco East, Western Australia, Australia, MZI Resources Ltd., 2 p. (Accessed October 28, 2015, at <http://www.mzi.com.au/index.php/investor-relations/asx-announcements/447-keysbrook-project-74-complete/download>.)
- MZI Resources Ltd., 2015b, Keysbrook mineral sands project: Subiaco East, Western Australia, Australia, MZI Resources Ltd., 5 p. (Accessed December 16, 2015, at <http://www.mzi.com.au/images/pdfs/Publications/00073700.pdf>.)
- Patel, Kasia, 2015, Twin Pines Minerals awards \$14 million mineral sands plant contract to Sedgman: Industrial Minerals, March 6. (Accessed June 20, 2015, via <http://www.indmin.com/>.)
- Rio Tinto plc, 2014, Delivering sustainable shareholder returns: London, United Kingdom, Rio Tinto investor seminar, December 4, 53 p. (Accessed September 11, 2015, at [http://www.riotinto.com/documents/20141204\\_Rio\\_Tinto\\_Investor\\_Seminar\\_London\\_presentation\\_slides.pdf](http://www.riotinto.com/documents/20141204_Rio_Tinto_Investor_Seminar_London_presentation_slides.pdf).)
- Southern Ionics Inc., 2013, Southern Ionics mining to support the American zirconium oxychloride (ZOC) business: West Point, MS, Southern Ionics Inc., presentation at TZMI Congress in Hong Kong, 33 p. (Accessed June 20, 2014, at [http://www.southernionics.com/mining/pdf/SII\\_TZMI\\_Congress\\_11\\_2013.pdf](http://www.southernionics.com/mining/pdf/SII_TZMI_Congress_11_2013.pdf).)
- Southern Ionics Inc., 2014, Governor Deal welcomes mining operation to Charlton County: West Point, MS, Southern Ionics Inc. press release, May 13, 2 p. (Accessed June 20, 2014, at [http://www.southernionics.com/mining/pdf/charlton\\_county\\_press\\_release.pdf](http://www.southernionics.com/mining/pdf/charlton_county_press_release.pdf).)
- Southern Ionics Inc., 2015, Grand opening of mineral sand plant in Pierce County: West Point, MS, Southern Ionics Inc. press release, May 5, 4 p. (Accessed June 16, 2015, at [http://www.southernionicsminerals.com/pdf/150507\\_press\\_release.pdf](http://www.southernionicsminerals.com/pdf/150507_press_release.pdf).)

Strandline Resources Ltd., 2014, Change of name and ASX code from 8 December 2014: West Perth, Western Australia, Australia, Gunson Resources Ltd. news release, December 8. (Accessed June 15, 2015, at <http://www.strandline.com.au/IRM/Company/ShowPage.aspx/PDFs/1793-98584778/ChangeofCompanyNameandASXCode>.)

Tronox Ltd., 2015, 2014 annual report: Stamford, CT, Tronox Ltd., 66 p. (Accessed October 28, 2015, at <http://www.tronox.com/wp-content/uploads/2015/05/TRONOX-Web.pdf>.)

TZ Minerals International Pty Ltd., 2014, Zircon annual review 2014: Victoria Park, Western Australia, Australia, TZ Minerals International Pty Ltd., July 2, 211 p.

World Titanium Resources, 2014, Building a tier 1 mineral sands company: Mount Claremont, Western Australia, Australia, World Titanium Resources, 18 p. (Accessed July 17, 2014, at [http://www.worldtitaniumresources.com/files/GMP\\_Mining\\_Jamboree\\_Feb\\_2014.pdf](http://www.worldtitaniumresources.com/files/GMP_Mining_Jamboree_Feb_2014.pdf).)

## GENERAL SOURCES OF INFORMATION

### U.S. Geological Survey Publications

Historical Statistics for Mineral and Material Commodities in the United States, Data Series 140.

Hafnium (Hf). Ch. in Metal Prices in the United States Through 2010, Scientific Investigations Report 2012–5188, 2013.

Zirconium. Ch. in United States Mineral Resources, Professional Paper 820, 1973.

Zirconium. International Strategic Minerals Inventory Summary Report, Circular 930–L, 1992.

Zirconium and Hafnium. Ch. in Mineral Commodity Summaries, annual.

Zirconium (Zr). Ch. in Metal Prices in the United States Through 2010, Scientific Investigations Report 2012–5188, 2013.

### Other

International Titanium Association.  
Mineral Sands Report, monthly.  
Roskill Information Services Ltd.  
Zirconium and Hafnium. Ch. in Mineral Facts and Problems, U.S. Bureau of Mines Bulletin 675, 1985.

TABLE 1  
SALIENT U.S. ZIRCONIUM AND HAFNIUM STATISTICS<sup>1</sup>

(Metric tons)

	2010	2011	2012	2013	2014
Zircon:					
Production:					
Concentrates	W	W	W	W	W
Milled zircon	46,900	53,600	48,200 <sup>r</sup>	48,200	43,300
Exports	47,400	24,300	20,000	29,200	7,460
Imports for consumption <sup>2</sup>	22,900	26,500	25,800	12,400	50,400
Consumption, apparent <sup>3</sup>	W	W	W	W	W
Zirconium oxide:					
Exports <sup>4</sup>	5,650 <sup>r</sup>	6,700 <sup>r</sup>	6,230	7,000	7,380
Imports for consumption <sup>4</sup>	2,930 <sup>r</sup>	3,010 <sup>r</sup>	4,550 <sup>r</sup>	3,170 <sup>r</sup>	4,240
Zirconium, unwrought, waste and scrap, other:					
Exports	2,060	2,000	1,800	1,740	1,450
Imports	1,160	875	567	714	1,100
Ferrozirconium:					
Exports	569	2,680	2,560	1,980	1,600
Imports	45	88	6 <sup>r</sup>	4	131
Hafnium, unwrought, waste and scrap, other, imports	6 <sup>r</sup>	10	24 <sup>r</sup>	10	21

<sup>r</sup>Revised. W Withheld to avoid disclosing company proprietary data.

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

<sup>2</sup>Includes insignificant amounts of baddeleyite.

<sup>3</sup>Defined as production plus imports for consumption minus exports plus or minus Government shipments.

<sup>4</sup>Includes germanium oxides and zirconium dioxides.

TABLE 2  
PUBLISHED YEAREND PRICES OF ZIRCONIUM MATERIALS

(Dollars per metric ton)

Material	2013	2014
Zircon:		
Domestic, standard-grade, bulk	950–1,150	950–1,150
Australian, standard-grade, free on board, bulk	1,150–1,250	1,000–1,050
Zirconia, fused, monoclinic, refractory/abrasive	6,500–7,800	6,000–6,900

Source: Industrial Minerals.

TABLE 3  
U.S. EXPORTS OF ZIRCONIUM, BY CLASS AND COUNTRY<sup>1</sup>

Class and country	HTS <sup>2</sup> code	2013		2014	
		Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
<b>Ore and concentrates:</b>	2615.10.0000				
Belgium		1,080	\$2,130	690	\$1,850
Brazil		218	449	13	55
Canada		3,570	2,330	466	1,370
Chile		572	937	123	203
China		13,200	17,300	216	564
Ecuador		49	87	24	38
France		595	1,630	658	1,920
Italy		882	1,400	248	491
Israel		68	235	62	177
Japan		645	1,540	381	1,150
Korea, Republic of		265	828	144	383
Mexico		3,940	7,000	2,990	5,920
Netherlands		525	705	15	45
Pakistan		72	119	24	36
Turkey		1,260	1,250	169	323
Ukraine		800	1,210	196	272
United Kingdom		1,290	3,580	667	2,310
Other		256 <sup>r</sup>	643 <sup>r</sup>	371	840
<b>Total</b>		<b>29,200</b>	<b>43,300</b>	<b>7,460</b>	<b>18,000</b>
<b>Ferrozirconium:</b>	7202.99.1000				
Mexico		1,830 <sup>r</sup>	4,680 <sup>r</sup>	1,570	3,860
Other		123	271	25	71
<b>Total</b>		<b>1,960 <sup>r</sup></b>	<b>4,960 <sup>r</sup></b>	<b>1,600</b>	<b>3,930</b>
<b>Unwrought zirconium, including powder:</b>	8109.20.0000				
Canada		10	513	7	309
China		(3)	5	--	--
France		96	4,650	2	125
Russia		52	3,550	16	1,090
Sweden		95	5,520	114	6,230
United Kingdom		145	3,360	138	2,700
Other		33	1,450	47	1,790
<b>Total</b>		<b>431 <sup>r</sup></b>	<b>19,100</b>	<b>325</b>	<b>12,200</b>
<b>Zirconium waste and scrap:</b>	8109.30.0000				
Belgium		63	594	65	905
Canada		25	1,570	43	2,490
Italy		27	608	7	159
Japan		26	463 <sup>r</sup>	7	137
Spain		7	651	--	--
Other		20	335	86	806
<b>Total</b>		<b>168</b>	<b>4,220</b>	<b>209</b>	<b>4,500</b>
<b>Other zirconium:</b>	8109.90.0000				
Argentina		39	6,940	16	1,640
Canada		346	34,500	356	32,300
China		49	5,320	58	6,090
France		60	6,620	47	2,120
Japan		46	2,950	49	4,650
Korea, Republic of		246	32,000	255	33,000
Spain		82	15,800	14	731
Sweden		82	10,600	53	7,570
United Kingdom		49	3,270	4	442
Other		142	7,580	59	4,530
<b>Total</b>		<b>1,140</b>	<b>126,000</b>	<b>913</b>	<b>93,000</b>

<sup>1</sup>Revised. -- Zero.

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

<sup>2</sup>Harmonized Tariff Schedule of the United States.

<sup>3</sup>Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 4  
U.S. IMPORTS FOR CONSUMPTION OF ZIRCONIUM AND HAFNIUM, BY CLASS AND COUNTRY<sup>1</sup>

Class and country	HTS <sup>2</sup> code	2013		2014	
		Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Zirconium ore and concentrates:	2615.10.0000				
Australia		20	\$33	18,200	\$22,300
China		284	1,290	213	894
Russia		559	2,510	860	3,880
South Africa		11,200	11,200	30,400	32,700
Other		299 <sup>r</sup>	520 <sup>r</sup>	735	1,000
Total		12,400	15,500	50,400	60,800
Ferrozirconium:	7202.99.1000				
Canada		4	44	40	307
China		--	--	91	467
Total		4	44	131	774
Unwrought zirconium, including powder:	8109.20.0000				
Belgium		--	--	3	57
Canada		--	--	18	204
China		28	1,550	381	20,900
Germany		41	3,560 <sup>r</sup>	74	3,940
Japan		101	659	84	760
Other		18 <sup>r</sup>	1,340	11	628
Total		188 <sup>r</sup>	7,110 <sup>r</sup>	570	26,500
Zirconium waste and scrap:	8109.30.0000				
Australia		116	176	175	243
Canada		26	485	3	62
China		2	12	--	--
France		2	47	28	312
Germany		--	--	10	220
Japan		27	134	26	130
Korea, Republic of		32	216	11	237
Other		3	94	18	213
Total		208	1,170	271	1,420
Other zirconium:	8109.90.0000				
Canada		31	3,540	21	2,050
China		16	1,160	1	107
France		252	48,700	197	43,200
Other		21 <sup>r</sup>	3,890	38	5,370
Total		321 <sup>r</sup>	57,300	257	50,700
Unwrought hafnium, including powder:	8112.92.2000				
France		4	2,460	11	6,160
Germany		5	2,190	8	3,900
Other		1	380	2	768
Total		10	5,030	21	10,800

<sup>r</sup>Revised. -- Zero.

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

<sup>2</sup>Harmonized Tariff Schedule of the United States.

Source: U.S. Census Bureau.

TABLE 5  
ZIRCONIUM MINERAL CONCENTRATES: WORLD PRODUCTION, BY COUNTRY<sup>1,2</sup>

(Metric tons)

Country <sup>3</sup>	2010	2011	2012	2013	2014 <sup>e</sup>
Australia	549,000	762,000	605,000	388,000 <sup>r</sup>	551,200 <sup>4</sup>
Brazil	23,236	23,283	20,425	22,000 <sup>r,e</sup>	22,000
China <sup>c</sup>	140,000	150,000	140,000	150,000	150,000
India	27,800 <sup>r</sup>	39,000 <sup>e</sup>	40,000 <sup>e</sup>	40,000 <sup>r,e</sup>	40,000
Indonesia <sup>c</sup>	50,000	130,000	120,000	120,000 <sup>r</sup>	110,000
Kenya	--	--	--	--	15,004 <sup>4</sup>
Madagascar	7,490	13,075	15,000 <sup>r,e</sup>	16,000 <sup>r,e</sup>	23,800
Malaysia	1,267	1,685	442	379 <sup>r</sup>	400
Mozambique	37,100	43,600	46,900	31,400 <sup>r</sup>	50,800
Russia <sup>5</sup>	9,308	8,914	7,969 <sup>r</sup>	9,000 <sup>r</sup>	8,000
Senegal	--	--	--	--	9,040 <sup>4</sup>
Sierra Leone	7,092	8,496	1,120 <sup>r</sup>	2,951 <sup>r,p</sup>	2,357 <sup>4</sup>
South Africa	383,000 <sup>r</sup>	427,000 <sup>r</sup>	400,000 <sup>r,e</sup>	210,000 <sup>r,p,e</sup>	386,547 <sup>4</sup>
Sri Lanka <sup>c</sup>	9,200 <sup>r,p</sup>	30,000	35,000	30,000 <sup>r,p</sup>	30,000
Ukraine <sup>c</sup>	30,000	26,000	20,000	41,000 <sup>r,p</sup>	40,000
United States	W	W	W	W	W
Vietnam <sup>6</sup>	6,852 <sup>r</sup>	13,862 <sup>r</sup>	15,558 <sup>r</sup>	7,587 <sup>r</sup>	8,514 <sup>4</sup>
Total	1,280,000 <sup>r</sup>	1,680,000	1,470,000 <sup>r</sup>	1,070,000 <sup>r</sup>	1,450,000

<sup>c</sup>Estimated. <sup>p</sup>Preliminary. <sup>r</sup>Revised. W Withheld to avoid disclosing company proprietary data; not included in "Total." -- Zero.

<sup>1</sup>World totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Includes data available through April 21, 2016.

<sup>3</sup>Small amounts of zirconium mineral concentrates were produced in various countries; however, information is not sufficient to estimate output.

<sup>4</sup>Reported figure.

<sup>5</sup>Production of baddeleyite concentrate averaging 98% ZrO<sub>2</sub>.

<sup>6</sup>Based on inferred exports of zirconium ore to China from Vietnam.