ZIRCONIUM AND HAFNIUM

(Data in metric tons unless otherwise noted)

Domestic Production and Use: In 2014, three firms mined zircon from surface-mining operations in Florida, Georgia, and Virginia. Zirconium metal and hafnium metal were produced from zirconium chemical intermediates by two domestic producers, one in Oregon and the other in Utah. The zirconium-silicate mineral zircon is produced as a coproduct from the mining and processing of heavy minerals. Typically, zirconium and hafnium are contained in zircon at a ratio of about 50 to 1. Zirconium chemicals were produced by the metal producer in Oregon and by at least 10 other companies. Ceramics, foundry applications, opacifiers, and refractories are the leading end uses for zircon. Other end uses of zircon include abrasives, chemicals, metal alloys, and welding rod coatings. The leading consumers of zirconium metal and hafnium metal are the nuclear energy and chemical process industries.

Salient Statistics—United States:	**2010**	**2011**	**2012**	**2013**	**2014[e]**
Production, zircon	W	W	W	W	W
Imports:					
Zirconium, ores and concentrates (ZrO_2 content)	14,900	17,200	16,700	8,050	28,300
Zirconium, unwrought, powder, and waste and scrap	726	487	279	395	805
Zirconium, wrought	423	396	288	319	307
Hafnium, unwrought, powder, and waste and scrap	6	10	23	10	21
Exports:					
Zirconium ores and concentrates (ZrO_2 content)	30,800	15,800	13,000	19,000	5,490
Zirconium, unwrought, powder, and waste and scrap	503	677	554	600	640
Zirconium, wrought	1,530	1,330	1,250	1,140	952
Consumption, zirconium ores and concentrates, apparent (ZrO_2 content)	W	W	W	W	W
Prices:					
Zircon, dollars per metric ton (gross weight):					
Domestic[1]	860	2,650	2,650	1,050	1,050
Imported[2]	1,093	2,122	2,533	996	1,106
Zirconium, unwrought, import, France, dollars per kilogram[3]	74	64	91	75	97
Hafnium, unwrought, import, France, dollars per kilogram[3]	453	544	503	578	568
Net import reliance[4] as a percentage of apparent consumption:					
Zirconium	E	<10%	<10%	E	<20%
Hafnium	NA	NA	NA	NA	NA

Recycling: Companies in Oregon and Utah recycled zirconium from scrap generated during metal production and fabrication. Scrap zirconium metal and alloys were recycled by companies in California and Oregon. Zircon foundry mold cores and spent or rejected zirconia refractories are often recycled. Hafnium metal recycling was insignificant.

Import Sources (2010–13): Zirconium mineral concentrates: South Africa, 60%; Australia, 35%; and other, 5%. Zirconium, unwrought, including powder: Japan, 49%; Germany, 31%; China, 8%; France, 6%; and other, 6%. Hafnium, unwrought: France, 50%; Australia, 23%; Germany, 21%; and other, 6%.

Tariff: Item	**Number**	**Normal Trade Relations 12–31–14**
Zirconium ores and concentrates	2615.10.0000	Free.
Germanium oxides and zirconium dioxide	2825.60.0000	3.7% ad val.
Ferrozirconium	7202.99.1000	4.2% ad val.
Zirconium, unwrought and zirconium powder	8109.20.0000	4.2% ad val.
Zirconium waste and scrap	8109.30.0000	Free.
Other zirconium articles	8109.90.0000	3.7% ad val.
Hafnium, unwrought, powder, and waste and scrap	8112.92.2000	Free.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile: None.

Prepared by **George M. Bedinger [(703) 648–6183, gbedinger@usgs.gov]**

ZIRCONIUM AND HAFNIUM

Events, Trends, and Issues: Domestic production of zirconium ores and concentrates continued at two mines near Stony Creek, VA, and one near Starke, FL. Operations at one of the Virginia mines were idled in April, and the associated mineral separation plant operated at reduced capacity in order to draw down existing inventories. Prices for zircon concentrates were also down from the all-time high prices of 2011 and 2012. U.S. imports increased by about 350% and exports decreased by about 71% owing to reduced domestic production and pent-up demand from the steel refractory and industrial consumers that deferred buying during the period of high prices.

In May, a new zircon mine started up in Charlton County, GA, and a second mine in Brantley County, GA, was expected to begin production in the fourth quarter 2015. A mineral sands plant in Pierce County, GA, was being constructed to process the heavy minerals from the two new mines and was expected to be completed in the second quarter 2015. The operator of the two mines in Virginia announced the decision to mine out deposits at both Virginia operations without further investment and was expected to compete mining and processing activities at these locations at the end of 2015.

Three significant heavy-mineral concentrate projects began production in 2014. In South Africa, the Tormin project began production of zircon and rutile concentrates in January and was expected to produce 48,000 tons per year of nonmagnetic concentrate grading 81% zircon and 11.6% rutile over a 4-year mine life. In Kenya, zircon production at the Kwale project began in February. Production of zircon was expected to be 30,000 tons per year during a mine life of 13 years. In Senegal, production began at the Grande Cote project in March 2014 with the first shipment of zircon made in August. At full production capacity, Grand Cote was expected to produce about 80,000 tons per year of zircon during a mine life of more than 20 years. Heavy-mineral exploration and mining projects were also underway in Australia, Madagascar, Mozambique, Tanzania, and Sri Lanka.

World Mine Production and Reserves: World primary hafnium production data are not available. Although hafnium occurs with zirconium in the minerals zircon and baddeleyite, quantitative estimates of hafnium reserves are not available.

	Zirconium mine production (thousand metric tons)		Zirconium reserves[5] (thousand metric tons, ZrO_2)
	2013	2014[e]	
United States	W	W	500
Australia	850	900	51,000
China	150	140	500
India	41	40	3,400
Indonesia	110	120	NA
Mozambique	47	56	1,100
South Africa	170	170	14,000
Other countries	140	110	7,200
World total (rounded)	[6]1,510	[6]1,540	78,000

World Resources: Resources of zircon in the United States included about 14 million tons associated with titanium resources in heavy-mineral sand deposits. Phosphate rock and sand and gravel deposits could potentially yield substantial amounts of zircon as a byproduct. World resources of hafnium are associated with those of zircon and baddeleyite. Quantitative estimates of hafnium resources are not available.

Substitutes: Chromite and olivine can be used instead of zircon for some foundry applications. Dolomite and spinel refractories can also substitute for zircon in certain high-temperature applications. Niobium (columbium), stainless steel, and tantalum provide limited substitution in nuclear applications, while titanium and synthetic materials may substitute in some chemical processing plant applications. Silver-cadmium-indium control rods are used in lieu of hafnium at numerous nuclear powerplants. Zirconium can be used interchangeably with hafnium in certain superalloys.

[e]Estimated. E Net exporter. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]Source: Industrial Minerals, yearend average of high-low price range.
[2]Unit value based on U.S. imports for consumption from Australia and South Africa.
[3]Unit value based on U.S. imports for consumption from France.
[4]Defined as imports – exports.
[5]See Appendix C for resource/reserve definitions and information concerning data sources.
[6]Excludes U.S. production.