

KYANITE AND RELATED MINERALS

(Data in thousand metric tons unless otherwise noted)

Domestic Production and Use: One firm in Virginia with integrated mining and processing operations produced kyanite from two hard-rock open pit mines and mullite by calcining kyanite. Another company produced synthetic mullite in Georgia from materials mined from two domestic sites, one in Alabama and the other in Georgia. Commercially produced synthetic mullite is made by sintering or fusing such feedstock materials as kyanite or bauxitic kaolin. Natural mullite occurrences typically are rare and uneconomic to mine. Of the kyanite-mullite output, 90% was estimated to have been used in refractories and 10% in other uses, including abrasive products such as motor vehicle brake shoes and pads and grinding and cutting wheels; ceramic products, such as electrical insulating porcelains, sanitaryware, and whiteware; foundry products and precision casting molds; and other products. An estimated 60% to 65% of the refractory usage was used by the iron and steel industries and the remainder was used by industries that manufacture chemicals, glass, nonferrous metals, and other materials. Andalusite was commercially mined in North Carolina as part of a mineral mixture of high-purity silica and alumina for use in a variety of refractory mineral products for the foundry and ceramics industries.

Salient Statistics—United States:	2010	2011	2012	2013	2014^e
Production:					
Mine ¹	93	98	99	110	100
Synthetic mullite ^e	40	40	40	40	50
Imports for consumption (andalusite)	2	5	3	4	3
Exports	38	38	36	42	38
Consumption, apparent ^e	97	105	105	112	115
Price, average, dollars per metric ton: ²					
U.S. kyanite, raw concentrate	283	335	340	300	310
U.S. kyanite, calcined	422	503	513	448	460
Andalusite, Transvaal, South Africa	336	300	300	348	350
Employment, kyanite mine, office, and plant, number ^{3, e}	115	120	125	135	150
Employment, mullite plant, office, and plant, number ^{3, e}	170	180	200	205	210
Net import reliance ⁴ as a percentage of apparent consumption	E	E	E	E	E

Recycling: Insignificant.

Import Sources (2010–13): South Africa, 79%; France, 9%; Peru, 9%; and other, 3%.

Tariff:	Item	Number	Normal Trade Relations
			12–31–14
	Andalusite, kyanite, and sillimanite	2508.50.0000	Free.
	Mullite	2508.60.0000	Free.

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

Government Stockpile: None.

Events, Trends, and Issues: Crude steel production in the United States, which ranked third in the world, increased by 1.5% in the first 8 months of 2014 compared with that of the same period in 2013, indicating a potential increase in consumption of kyanite-mullite refractories if the trend continues. Mostly as the result of increases in steel production in Asia, total world steel production rose by 3.7% during the first 8 months of 2014 compared with 2.9% in the same period in 2013. Of the total world refractories market, estimated to be approximately 40 million metric tons, crude steel manufacturing consumed more than 70% of refractories production.

Slow growth in world steel production during 2014 was, in part, the result of a sluggish economy in Western Europe and slower-than-expected economic growth in Eastern Europe and the United States. With steel production continuing to expand in Asia, andalusite and mullite could receive increasing consideration as alternative aluminosilicate refractory minerals to refractory bauxite owing to a continuing lack of readily available, inexpensive refractory-grade bauxite from China, which accounted for about three-quarters of market share worldwide.

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China is expected to continue to be the largest market for refractories, comprising the majority of global demand. Slowing, but still above-average, growth is expected in India. Eastern Europe, North America, and Western Europe are expected to continue to have significant refractory demand because of their large industrial bases. North America and Western Europe are expected to continue to increase slowly in the near term with recovery in manufacturing and steel production, but may lag behind the worldwide average in the longer term with steel production increasing in and shifting to less-developed countries. Demand for refractories in iron and steel production is expected to have greater increases in countries with higher rates of growth in steel production. Increased demand also is anticipated for refractories used to produce other metals and in the industrial mineral market because of increasing production of cement, ceramics, glass, and other mineral products.

Andalusite projects in Peru progressed. One facility increased production capacity by 50% and planned an increase of nearly as much for 2015. Exploration continued at another deposit and development of a processing operation was planned with production to begin in 2016. Large resources of kyanite were discovered in the far northwest region of Russia.

World Mine Production and Reserves:

	Mine production		Reserves ⁵
	2013	2014 ^e	
United States ^e	110	100	Large
France	70	70	NA
India	63	65	1,600
South Africa	220	170	NA
Other countries	<u>1</u>	<u>15</u>	<u>NA</u>
World total (rounded)	464	420	NA

World Resources: Large resources of kyanite and related minerals are known to exist in the United States. The chief resources are in deposits of micaceous schist and gneiss, mostly in the Appalachian Mountains and in Idaho. Other resources are in aluminous gneiss in southern California. These resources are not economical to mine at present. The characteristics of kyanite resources in the rest of the world are thought to be similar to those in the United States. Significant resources of andalusite are known to exist in China, France, Peru, and South Africa; kyanite, in Brazil and India; and sillimanite, in India.

Substitutes: Two types of synthetic mullite (fused and sintered), superduty fire clays, and high-alumina materials are substitutes for kyanite in refractories. Principal raw materials for synthetic mullite are bauxite, kaolin and other clays, and silica sand.

^eEstimated. E Net exporter. NA Not available.

¹Source: Virginia Department of Mines, Minerals and Energy.

²Source: Average of prices reported in Industrial Minerals.

³Includes mine, mill, and office employment. Source: Mine Safety and Health Administration.

⁴Defined as imports – exports.

⁵See [Appendix C](#) for resource/reserve definitions and information concerning data sources.