

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. Two other companies produced synthetic mullite, one in Alabama and another in Georgia from materials mined from four sites. Each company sourced materials from one site in Alabama and one site in Georgia; these data are withheld to avoid disclosing company proprietary data. 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 consumed 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 from a pyrophyllite-andalusite deposit in North Carolina for use in a variety of refractory mineral products for the foundry and ceramics industries.

Salient Statistics—United States:	2011	2012	2013	2014	2015^e
Production:					
Mine	¹ 98	¹ 99	^e 100	^e 110	110
Synthetic mullite	W	W	W	W	W
Imports for consumption (andalusite)	5	3	4	4	8
Exports	38	36	42	40	40
Consumption, apparent	W	W	W	W	W
Price, average, dollars per metric ton: ²					
U.S. kyanite, raw concentrate	335	340	300	270	290
U.S. kyanite, calcined	503	513	448	410	440
Andalusite, Transvaal, South Africa	300	300	348	370	380
Employment, kyanite mine, office, and plant, number ^{3, e}	120	125	135	150	150
Employment, mullite plant, office, and plant, number ^{3, e}	180	185	190	200	200
Net import reliance ⁴ as a percentage of apparent consumption	E	E	E	E	E

Recycling: Insignificant.

Import Sources (2011–14): South Africa, 82%; France, 8%; Peru, 6%; and other, 4%.

Tariff: Item	Number	Normal Trade Relations 12–31–15
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 fourth in the world, decreased by 8.5% in the first 8 months of 2015 compared with that of the same period in 2014, indicating a potential decrease in consumption of kyanite-mullite refractories if this trend continues. Total world steel production decreased by 2.3% during the first 8 months of 2015 compared with a 3.7% increase in the same period in 2014, mostly as the result of decreases in steel production in China, Japan, the Republic of Korea, and the United States. Of the total world refractories market, which was estimated to be approximately 40 million metric tons, crude steel manufacturing consumed more than 70% of refractories production.

The decrease in world steel production during the first 8 months of 2015 was, in part, the result of a deceleration in growth in China, a continued sluggish economy in Western Europe, slower-than-expected economic growth in Eastern Europe, and lower steel demand in the United States. Although steel production and consumption was expected to be lower than previously forecast for 2015, gradual improvements were expected in 2016. Andalusite and mullite could receive increasing consideration as alternative aluminosilicate refractory minerals to refractory bauxite; a lack of readily available, inexpensive refractory-grade bauxite from China, which accounted for about three-quarters of market share worldwide, has continued.

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Although experiencing an economic slowdown, China is expected to continue to have growth rates of 6% to 7% and to be the largest market for refractories, comprising the majority of global demand. Slowing, but still above-average, growth is expected in India and portions of Asia. Eastern Europe, North America, and Western Europe are expected to have sluggish but continuing refractory demand because of their large industrial bases. The economies of North America and Western Europe are expected to increase in 2016 with recovery in manufacturing and steel production, but may lag behind the worldwide average in the longer term with steel production increasing in India and shifting to less-developed countries, such as Egypt, Indonesia, and Vietnam. 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 continued to progress. One facility increased production capacity by 50% and planned to increase by about 25% more in 2016. Exploration continued at another deposit in Peru and development of a processing operation was planned with production to begin in 2016. Large resources of kyanite were discovered in Murmansk in the Kola Peninsula region of Russia.

World Mine Production and Reserves:

	Mine production		Reserves ⁵
	2014	2015 ^e	
United States ^e (kyanite)	110	110	Large
India (kyanite and sillimanite)	62	65	1,600
Peru (andalusite)	30	35	NA
South Africa (andalusite)	200	200	NA
Other countries	1	10	NA
World total (rounded)	⁶ 403	⁶ 420	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, Russia, 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, W Withheld to avoid disclosing company proprietary data.

¹Sources: 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.

⁶In addition to the countries listed, France continued production of andalusite and Brazil and China produced kyanite and related minerals. Output is not reported quantitatively, and no reliable basis is available for estimation of output levels.