

KYANITE AND RELATED MINERALS

(Data in metric tons unless otherwise noted)

Domestic Production and Use: In Virginia, one firm with integrated mining and processing operations produced kyanite from two hard-rock open pit mines and synthetic mullite by calcining kyanite. Two other companies, one in Alabama and another in Georgia, produced synthetic mullite from materials mined from four sites; each company sourced materials from one site in Alabama and one site in Georgia. Synthetic mullite production data are withheld to avoid disclosing company proprietary data. Commercially produced synthetic mullite is made by sintering or fusing such feedstock materials as kyanite, kaolin, bauxite, 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 use was by the iron and steel industries, and the remainder was by industries that manufacture chemicals, glass, nonferrous metals, and other materials. Andalusite was commercially mined from an andalusite-pyrophyllite-sericite deposit in North Carolina and processed as a blend of primarily andalusite for use by producers of refractories in making firebrick.

Salient Statistics—United States:	2014	2015	2016	2017	2018^e
Production:					
Mine	188,600	1109,000	179,700	191,300	95,000
Synthetic mullite	W	W	W	W	W
Imports for consumption (andalusite)	4,020	11,500	2,510	7,430	9,000
Exports (kyanite)	40,000	39,900	37,100	42,400	45,000
Consumption, apparent	W	W	W	W	W
Price, average, dollars per metric ton: ²					
U.S. kyanite, raw concentrate	260	270	270	270	270
U.S. kyanite, calcined	370	410	410	420	420
Andalusite, Transvaal, South Africa	340	330	330	340	360
Employment, kyanite mine, office, and plant, number ^e	150	155	150	140	150
Employment, mullite plant, office, and plant, number ^e	230	220	210	200	200
Net import reliance ³ as a percentage of apparent consumption	E	E	E	E	E

Recycling: Insignificant.

Import Sources (2014–17): South Africa, 75%; Peru, 19%; France, 4%; China 1%, and other, 1%.

Tariff: Item	Number	Normal Trade Relations 12–31–18
Andalusite, kyanite, and sillimanite	2508.50.0000	Free.
Mullite	2508.60.0000	Free.

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

Government Stockpile: None.

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Events, Trends, and Issues: Crude steel production in the United States, which ranked fourth in the world, increased by about 4% in the first 8 months of 2018 compared with that of the same period in 2017, indicating a similar change in consumption of kyanite-mullite refractories. Total world steel production increased by nearly 5% during the first 8 months of 2018 compared with that of the same period in 2017. The increase in world steel production during the first 8 months of 2018 was the result of incremental to small increases in production in developed and developing countries, especially in Asia. Despite a continuing deceleration in growth, China still led with the largest increase in steel production and continued to be the largest market for refractories. Of the total world refractories market, which was estimated to be approximately 40 million tons, crude steel manufacturing consumed more than 70% of refractories production.

The availability of inexpensive refractory-grade bauxite from China, which accounted for about three-quarters of the refractories market share worldwide, continued to decrease, in part owing to inspections by the Government of China and the shutdown of some operations during the past few years because of environmental problems. Andalusite and mullite could receive increased consideration as alternative aluminosilicate refractory minerals to refractory bauxite, if the availability of andalusite in 2019 can meet the rising demand for the mineral. The mine disruptions caused by heavy rain during 2017 at major andalusite operations in South Africa and Peru followed prolonged rampup to full capacity and resulted in shortages of andalusite to supply existing and future orders. Contracts for orders for andalusite of shorter than traditional duration, typically with an increase in prices, began in 2018 and were expected to continue in 2019. Higher consumption of refractories in iron and steel production is expected in countries with higher rates of growth in steel production.

Although still recovering from the adverse weather conditions of 2017, andalusite projects in Peru continued to progress. At one andalusite project, the company continued exploration and construction of a processing facility as it sought a joint-venture investment partner, which was deemed necessary to proceed with production.

World Mine Production and Reserves: Reserves data for India were revised based on Government information.

	Mine production		Reserves ⁴
	2017	2018 ^e	
United States (kyanite)	91,300	95,000	Large
India (kyanite and sillimanite)	68,000	70,000	7,190,000
Peru (andalusite)	35,000	40,000	NA
South Africa (andalusite)	200,000	200,000	NA
World total (rounded)	⁵ NA	⁵ NA	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 economic 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 resources have been identified in Brazil, India, and Russia; and sillimanite has been identified 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.

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

²Source: Average of prices reported in Industrial Minerals.

³Defined as imports – exports.

⁴See Appendix C for resource and reserve definitions and information concerning data sources.

⁵In addition to the countries listed, France continued production of andalusite and Cameroon and China produced kyanite and related minerals. Output is not reported quantitatively, and no reliable basis is available for estimation of output levels.