

## 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 an estimated 90,000 tons of kyanite worth \$33 million 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.

<b>Salient Statistics—United States:</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019<sup>e</sup></b>
Production:					
Mine	1109,000	179,700	191,300	189,200	90,000
Synthetic mullite	W	W	W	W	W
Imports for consumption (andalusite)	11,500	2,510	7,420	8,590	9,000
Exports (kyanite)	39,900	37,100	42,400	43,000	40,000
Consumption, apparent <sup>2</sup>	W	W	W	W	W
Price, average, dollars per metric ton: <sup>3</sup>					
U.S. kyanite, raw concentrate	270	270	270	NA	NA
U.S. kyanite, calcined	410	420	420	NA	NA
Employment, kyanite mine, office, and plant, number <sup>e</sup>	155	150	140	150	150
Employment, mullite plant, office, and plant, number <sup>e</sup>	220	210	200	200	200
Net import reliance <sup>4</sup> as a percentage of apparent consumption	E	E	E	E	E

**Recycling:** Insignificant.

**Import Sources (2015–18):** South Africa, 75%; Peru, 19%; France, 4%; and other, 2%.

<b>Tariff: Item</b>	<b>Number</b>	<b>Normal Trade Relations 12-31-19</b>
Andalusite, kyanite, and sillimanite	2508.50.0000	Free.
Mullite	2508.60.0000	Free.

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**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, increased by about 4% in the first 8 months of 2019 compared with that of the same period in 2018, indicating a similar change in consumption of kyanite-mullite refractories. Total world steel production similarly increased by about 4% during the first 8 months of 2019 compared with that of the same period in 2018. The increase in world steel production during the first 8 months of 2019 was the result of sustained growth in China with a 9% increase in steel production. The steel industry continued to be the largest market for refractories.

In June 2019, a company in South Africa suspended production for more than 1 month after entering business rescue proceedings resulting from financial setbacks. The company accounted for almost one-third of global andalusite output. The complications were the result of low prices and weakening demand for refractories globally. Bauxite and mullite could receive increased consideration as alternatives to refractory andalusite, if andalusite producers are unable to meet demand in 2020.

### **World Mine Production and Reserves:**

	<b>Mine production</b>		<b>Reserves<sup>5</sup></b>
	<b>2018</b>	<b>2019<sup>e</sup></b>	
United States (kyanite)	189,200	90,000	Large
India (kyanite and sillimanite)	101,000	110,000	7,190,000
Peru (andalusite)	40,000	40,000	NA
South Africa (andalusite)	200,000	190,000	NA
World total (rounded)	<sup>6</sup> NA	<sup>6</sup> 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.

<sup>e</sup>Estimated. E Net exporter. NA Not available. W Withheld to avoid disclosing company proprietary data.

<sup>1</sup>Source: Virginia Department of Mines, Minerals and Energy.

<sup>2</sup>Defined as production + imports – exports.

<sup>3</sup>Source: Average of prices reported in Industrial Minerals.

<sup>4</sup>Defined as imports – exports.

<sup>5</sup>See Appendix C for resource and reserve definitions and information concerning data sources.

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