

## 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 81,000 tons of kyanite worth \$30 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 not economical 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 70% of the refractory use was by the iron and steel industries, and the remainder was by industries that manufacture cement, 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. Another company mined mineral sands within the southeastern United States; product blends that included kyanite and (or) sillimanite were marketed to the abrasive, foundry, and refractory industries.

<b><u>Salient Statistics—United States:</u></b>	<b><u>2017</u></b>	<b><u>2018</u></b>	<b><u>2019</u></b>	<b><u>2020</u></b>	<b><u>2021<sup>e</sup></u></b>
Production:					
Kyanite, mine	191,300	189,200	191,300	167,100	81,000
Synthetic mullite	W	W	W	W	W
Imports for consumption (andalusite)	7,420	8,590	6,960	710	1,000
Exports (kyanite)	42,400	43,000	40,100	37,400	45,000
Consumption, apparent <sup>2</sup>	W	W	W	W	W
Price, average value of exports (free alongside ship), <sup>3, 4</sup> dollars per metric ton	350	347	358	369	369
Employment, number: <sup>e</sup>					
Kyanite, mine, office, and plant	140	150	150	140	140
Synthetic mullite, office and plant	200	200	200	200	200
Net import reliance <sup>5</sup> as a percentage of apparent consumption	E	E	E	E	E

**Recycling:** Insignificant.

**Import Sources (2017–20):**<sup>4</sup> South Africa, 77%; Peru, 12%; France, 7%; United Kingdom, 3%; and other, 1%.

<b><u>Tariff:</u></b>	<b><u>Item</u></b>	<b><u>Number</u></b>	<b><u>Normal Trade Relations</u></b>
			<b><u>12–31–21</u></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 20% in the first 8 months of 2021 compared with that of the same period in 2020, indicating a similar change in consumption of kyanite-mullite refractories. Total world steel production increased by about 11% during the first 8 months of 2021 compared with that of the same period in 2020. The increase in world steel production during the first 8 months of 2021 was the result of economic recovery from the global COVID-19 pandemic. The steel industry continued to be the largest market for refractories.

In January 2021, a company in South Africa that accounted for nearly one-third of global andalusite output announced that a new investor and owner had been approved. In mid-2019, the company entered into business rescue proceedings attributed to financial problems but was expected to emerge from business rescue status and be transferred to the new owner.

Despite strong demand, andalusite output was hindered by several challenges that contributed to a prolonged and uneven recovery period from the pandemic. Although many countries declared mining essential, production efforts were constrained by ongoing logistical and shipping issues, renewed COVID-19 outbreaks, and supply chain disruptions. If andalusite producers are unable to meet demand, market participants may consider alternatives such as bauxite and mullite, although these materials experienced similarly problematic market conditions in 2021.

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

	<b>Mine production</b>		<b>Reserves<sup>6</sup></b>
	<b><u>2020</u></b>	<b><u>2021<sup>e</sup></u></b>	
United States (kyanite)	167,100	81,000	Large
India (kyanite and sillimanite)	61,000	70,000	7,200,000
Peru (andalusite)	<sup>e</sup> 40,000	40,000	NA
South Africa (andalusite)	<u>180,000</u>	<u>190,000</u>	<u>NA</u>
World total (rounded)	<sup>7</sup> NA	<sup>7</sup> NA	NA

**World Resources:**<sup>6</sup> 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 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>Calculated from U.S. Census Bureau export data.

<sup>4</sup>Includes data for the following Harmonized Tariff Schedule of the United States code: 2508.50.0000.

<sup>5</sup>Defined as imports – exports.

<sup>6</sup>See Appendix C for resource and reserve definitions and information concerning data sources.

<sup>7</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.