USGS
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2020 Minerals Yearbook

NIOBIUM [ADVANCE RELEASE]

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U.S. Geological Survey

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Niobium

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In 2020, U.S. niobium apparent consumption (niobium content) was 6,330 metric tons (t), a decrease of 32% compared with 9,370 t in 2019 (table 1). No domestic mine production of niobium ore was reported. The niobium content of world mine production was 67,700 t, 30% less than that in 2019 (tables 1, 4). The United States imported 7,200 t of niobium contained in niobium-bearing metal, alloys, ores, and concentrates, a decrease of 29% compared with 10,100 t in 2019. In the same period, the United States exported 785 t of niobium contained in niobium-bearing alloys, ores, and concentrates, an increase of 18% compared with exports in 2019. U.S. foreign trade of niobium materials included ferroniobium and niobium metal, ores and concentrates, and scrap. Ferroniobium was the leading imported and exported niobium material to and from the United States in terms of value (table 3). The leading reported end use of niobium in the United States was as an alloying element in superalloys, followed by carbon steel and stainless steel (table 2).

Government Actions and Legislation

Niobium was first added to the U.S. Government stockpile in 1943 (as columbite ore), and the U.S. Congress designated niobium as a strategic and critical material in 1946 by means of the Strategic and Critical Materials Stock Piling Act as amended through P.L. 79–520, July 23, 1946 (DeMille, 1947, p. 135). The United States is heavily reliant on imports of certain mineral commodities vital to the Nation's security and economic prosperity. On May 18, 2018, under Executive Order 13817, the U.S. Department of the Interior published a list of 35 critical mineral commodities that included niobium. Dependency on foreign sources creates a strategic vulnerability for the U.S. economy and military to adverse foreign government action, natural disasters, and other events that can disrupt the supply of critical minerals (U.S. Department of the Interior, 2018). The Defense Logistics Agency Strategic Materials, U.S. Department of Defense, did not designate niobium materials for potential acquisition or disposal from the National Defense Stockpile under its fiscal year 2021 Annual Materials Plan (Defense Logistics Agency Strategic Materials, 2020a, b).

Production

Globally, pyrochlore is the leading mineral mined for niobium. Niobium minerals typically are converted to ferroniobium and other value-added products at the mine site. The primary marketable niobium materials are ferroniobium and niobium metal, ore, and oxide. Niobium resources in the United States are small, low grade, and difficult to recover and process compared with higher grade resources found in major global producers. As a result, domestic supply has been a concern during military engagements since the mid-20th century, particularly owing to its essential role in defense technologies and reliance on foreign imports. In 2020, no domestic niobium mine production was reported. Recycled materials and stocks were the only domestic sources of niobium.

NioCorp Developments Ltd. (Centennial, CO), a resource company developing a niobium deposit in Elk Creek, NE, announced that its primary focus in 2020 was on ensuring financing, advancing detailed engineering of the exterior and subsurface facilities, acquiring the final State of Nebraska air construction permit, and securing the land parcel agreements for Johnson and Pawnee Counties. In September 2020, NioCorp stated that advances by its technical team had uncovered a potential alternative metallurgical method using carbonation for extracting niobium from the Elk Creek Project (NioCorp Developments Ltd., 2021, p. 1, 36–37). When active, the mining operation was expected to produce 169,000 t of ferroniobium, 3,410 t of scandium oxide, and 419,000 t of titanium dioxide over a 36-year mine life (NioCorp Developments Ltd., 2019, p. 31, 68).

Consumption

Domestic consumption data of niobium materials were developed by the U.S. Geological Survey by means of the "Columbium (Niobium) and Tantalum," "Consolidated Consumers," and "Specialty Ferroalloys" surveys to companies.

Total domestic apparent consumption of niobium was estimated to be 6,330 t in 2020, a 32% decrease compared with that in 2019 (table 1). Reported consumption of niobium by the steel industry was 4,140 t in 2020, a 19% decrease compared with 5,100 t reported consumption in 2019 (table 2). Ferroniobium, the leading niobium material consumed, was typically used in the production of high-strength low-alloy (HSLA) steel and stainless steel. Other uses included the fabrication of nonferrous and niobium alloys and production of niobium carbides and chemicals.

Prices

Niobium materials were not openly traded on exchanges. Purchase contracts were confidential between buyer and seller. Based on U.S. Census Bureau data for 2020, the average unit value of traded (imported plus exported) niobium-containing materials was $33.58 per kilogram for niobium oxide (Nb_2O_5) (a 5% decrease compared with that in 2019), $26.62 per kilogram for niobium ores and concentrates (more than double compared with that in 2019), and $20.77 per kilogram for ferroniobium (a 9% decrease compared with that in 2019) (tables 1, 3).

Foreign Trade

According to the U.S. Census Bureau, the United States exported niobium materials valued at $15.9 million in 2020 (an increase of 28% from that in 2019) and imported niobium

materials valued at $295 million (a 33% decrease from that in 2019) (table 3). Traded niobium materials included ferroniobium and niobium concentrates, metal, ores, and oxide. In 2020, exports of ferroniobium increased by 18% compared with those in 2019 and imports for consumption decreased by 27%. Ferroniobium was the leading niobium material traded by value, accounting for 62% of the total import value and 83% of the total export value. In 2020, Brazil continued to be the leading supplier of ferroniobium and niobium metal and oxides. When ranked according to gross weight, Mexico, China, and Canada were the leading destinations for United States ferroniobium exports.

World Industry Structure

Niobium ore was mined primarily in Brazil, Canada, and countries in the Great Lakes region of Africa, including Congo (Kinshasa) and Rwanda, and typically was beneficiated to concentrates containing 55% to 60% Nb_2O_5. Concentrates were further processed to produce ferroniobium or niobium metal and oxides. Ferroniobium, the leading commercial niobium-containing material, typically contained about 66% niobium (Roskill Information Services Ltd., 2020, p. 110).

In 2020, world production of niobium contained in cassiterite, columbite-tantalite (coltan), loparite, and pyrochlore concentrates equaled 67,700 t (table 4), a decrease of 30% compared with that in 2019. World production of ferroniobium, in terms of niobium content, was estimated to be 64,900 t, a slight decrease from that in 2019 (table 5). Brazil and Canada were the leading producers of ferroniobium (table 5) and niobium mineral concentrates (table 4), accounting for more than 99% of global ferroniobium production and 98% of global niobium mineral concentrates production.

In Brazil, the leading producers were Companhia Brasileira de Metalurgia e Mineração (CBMM) and Niobras Mineração Ltda. [a subsidiary of China Molybdenum Co., Ltd. (China)]. In Canada, the leading producer was Niobec Inc. (a subsidiary of Magris Resources Inc.).

World Review

Australia.—In March, Alkane Resources Ltd. reported interest in financing of its Dubbo Project (located in the Central West Region of the State of New South Wales) from Export Finance Australia, the Australian Government's Export Credit Agency. The Dubbo Project contains resources of hafnium, niobium, rare-earth elements, yttrium, and zirconium. The project was ready for development pending financing, had secured the mineral deposit and surrounding land, received all major State and Federal approvals, and completed all piloting and engineering studies (Alkane Resources Ltd., 2020a, b).

Brazil.—CBMM reported that it produced 74,220 t in gross weight of niobium products in 2020, including 68,850 t of ferroniobium, at its mining and industrial complex in Araxa, Minas Gerais State. This production represented a 40% decrease from the 122,900 t of niobium products produced in 2019. In 2020, CBMM completed a facility expansion at its plant in Araxa, increasing the company's total production capacity of ferroniobium to 150,000 metric tons per year (Companhia Brasileira de Metalurgia e Mineração, 2021, p. 3, 11, 35).

Mineração Taboca S.A. [a subsidiary of MINSUR S.A. (Peru)] operated the Pitinga-Pirapora Mine complex in Amazonas State. In 2020, the company reported production of 3,480 t in gross weight of niobium and tantalum ferroalloys with an average combined niobium and tantalum content of 47%, an 11% decrease compared with total ferroalloy production in 2019. MINSUR reported that the production decrease was due to operational stoppages and a reduction of workforce as a result of the global coronavirus disease 2019 (COVID-19) pandemic (MINSUR S.A., 2020, p. 30).

Niobras Mineração, a subsidiary of China Molybdenum, operated the Boa Vista Mine and ferroalloy plant in Goias State. In 2020, China Molybdenum reported that it produced 9,300 t of niobium contained in ferroniobium, a 24% increase compared with 7,490 t in 2019 (China Molybdenum Co., Ltd., 2021, p. 23).

Canada.—In 2020, NioBay Metals Inc., owner of the James Bay Niobium Project located in the Province of Ontario, announced an updated mineral resource estimate for the deposit. In July, results of the estimate confirmed mineralization grades similar to those reported in the 2018 estimate. The results used a cutoff grade of 0.3% Nb_2O_5 and showed a niobium oxide content of 14% for indicated resources and 37% for inferred resources (NioBay Metals Inc., 2020b, c). In December, NioBay announced final preparations for its 2021 drilling program set to begin January 2021; the program's objective was to convert the inferred resources into the indicated resources category (NioBay Metals Inc., 2020a).

Russia.—LLC Lovozero GOK operated the Lovozero Mine in Murmansk Province. The company produced loparite mineral concentrates used by the JSC Solikamsk Magnesium Works (SMZ) facility to produce niobium compounds in Perm Kray. In 2020, SMZ reported 617 t of Nb_2O_5 content in shipments of niobium compounds, a 6% decrease compared with 659 t in 2019. More than 90% of shipments were sent primarily to consumers in Russia, with most of the remaining amount sent to the Americas and Europe (JSC Solikamsk Magnesium Works, 2020, p. 12–14).

Tanzania.—In April, Tanzania's Ministry of Minerals reported interest in reinitiating niobium deposit development in the Mbeya region. Development of the Panda Hill deposit was halted in 2017 owing to changes in the legal framework governing the mining sector (Stevens, 2020). According to a 2016 definitive feasibility study, the deposit's estimated total carbonatite mineral resources were 178 million metric tons, grading an estimated 0.50% Nb_2O_5 (Cradle Resources Ltd., 2016).

Venezuela.—In July 2019, the Government of Venezuela reported the commissioning of the state-owned Las Bendiciones coltan ore processing plant in the El Burro sector of the Orinoco Mining Arc. The production from the plant would feed a coltan mineral concentration plant in Ciudad Piar. Company reports anticipated that the facility would process 20 metric tons per month of coltan ore (Diaz, 2019).

Outlook

Currently, operating niobium mines have adequate reserves to meet global demand for the foreseeable future (U.S. Geological Survey, 2021). The steel industry is the largest consumer of niobium (mainly in HSLA steel), and niobium content of HSLA

steel is greatest in developed countries, indicating that niobium use in steel could increase in developing nations. Potential new sources of niobium are typically as a niobium byproduct of the production of other minerals. Several potential new niobium sources were in development during 2020, mostly in Australia and Canada.

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TABLE 1
SALIENT NIOBIUM STATISTICS[1]

		2016	2017	2018	2019	2020
United States:						
Exports:						
Niobium ores and concentrates, gross weight	metric tons	14	7	5	27	4
Synthetic concentrates, gross weight	do.	379	113	198	40	120
Tantalum ores and concentrates, gross weight	do.	162	109	48	28	10
Niobium-containing ores and concentrates,[2] niobium (Nb) content[e]	do.	64	26	28	13	15
Ferroniobium, Nb content[e]	do.	1,410	1,460	926	655	770
Total exports, Nb content	do.	1,480	1,490	955	668	785
Imports for consumption:						
Niobium ores and concentrates, gross weight	do.	1	1	31	3	4
Synthetic concentrates, gross weight	do.	9	15	12	6	6
Tantalum ores and concentrates, gross weight	do.	675	1,010	1,050	840	693
Niobium-containing ores and concentrates,[2] Nb content[e]	do.	77	115	126	95	79
Niobium metal, Nb content[3]	do.	1,240	1,410	1,800	1,700	1,220
Niobium oxide, Nb content[e]	do.	855	895	964	994	519
Ferroniobium, Nb content[e]	do.	6,080	6,910	8,290	7,330	5,380
Total imports, Nb content	do.	8,250	9,330	11,200	10,100	7,200
Reported consumption, Nb content:						
Raw materials	do.	W	W	W	W	W
Ferroniobium and nickel niobium	do.	7,370	7,640	6,850	6,680	5,120
Apparent consumption, Nb content[4]	do.	6,730	7,780	10,100	9,370	6,330 [e]
Unit value,[5] gross weight:						
Niobium ores and concentrates	dollars per kilogram	7.81	20.69	15.08	11.33	26.62
Niobium oxide	do.	33.66	31.20	35.03	35.42	33.58
Ferroniobium	do.	20.56	19.83	21.11	22.71	20.77
World, production of niobium concentrates, Nb content[6]	metric tons	58,400	66,800	78,800	97,000	67,700

[e]Estimated. [r]Revised. do. Ditto. W Withheld to avoid disclosing company proprietary data.

[1]Table includes data available through September 21, 2021. Data are rounded to no more than three significant digits, except values; may not add to totals shown.

[2]Includes natural and synthetic niobium-containing ores and concentrates. Nb content of ores and concentrates was estimated assuming the following niobium oxide (Nb_2O_5) contents: 30% in niobium ore, 16% in synthetic concentrates, and 16% in tantalum ore. The Nb content of Nb_2O_5 is 69.904%.

[3]Includes niobium and articles made of niobium.

[4]Defined as imports minus exports plus adjustments for Government stock changes.

[5]Weighted average unit value of imported plus exported materials.

[6]May include estimated data.

Sources: U.S. Census Bureau and U.S. Geological Survey.

TABLE 2
REPORTED CONSUMPTION, BY END USE, INDUSTRY STOCKS OF FERRONIOBIUM AND NICKEL NIOBIUM, AND GOVERNMENT STOCKS BY MATERIAL IN THE UNITED STATES[1]

(Metric tons, niobium content)

	2019	2020
End use:		
Steel:		
Carbon	1,120	695
Stainless and heat-resisting	617	324
Full alloy	285	278
High-strength low-alloy	(2)	(2)
Electric	(2)	(2)
Tool	(2)	(2)
Unspecified	3,080	2,850
Total	5,100	4,140
Superalloys	1,560	971
Alloys (excluding steels and superalloys)	21	4
Grand total	6,680	5,120
Stocks, December 31:		
Consumer	536 r	492
Producer[3]	W	W
Total	536 r	492
National Defense Stockpile, total uncommitted inventory by material:		
Ferroniobium	265	353
Niobium metal ingots	10	10

rRevised. W Withheld to avoid disclosing company proprietary data.
[1]Table includes data available through June 30, 2021. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Included with "Steel, unspecified."
[3]Ferroniobium only.

TABLE 3
U.S. FOREIGN TRADE IN NIOBIUM, BY CLASS[1]

HTS[2] code or Schedule B number	Class	2019 Gross weight (kilograms)	2019 Value (thousands)	2020 Gross weight (kilograms)	2020 Value (thousands)	Principal destinations and sources in 2020 (gross weight in kilograms and values in thousand dollars)
	Exports:					
2615.90.3000	Synthetic concentrates	40,100	$975	120,000	$2,110	Estonia 95,400, $798; Germany 23,300, $1,291.
2615.90.6030	Niobium ores and concentrates	26,900	163	4,380	126	India 2,870, $83; China 1,090, $31.
2615.90.6060	Tantalum ores and concentrates[3]	27,800	168	9,690	525	Austria 7,430, $443; Netherlands 2,000, $66.
7202.93.0000	Ferroniobium	1,010,000	11,200	1,180,000	13,100	Mexico 689,000, $7,570; China 377,000, $4,150; Canada 83,800, $1,050.
	Total exports	XX	12,500	XX	15,900	
	Imports for consumption:					
2615.90.3000	Synthetic concentrates	5,810	31	6,280	199	Singapore 4,620, $149; Canada 1,660, $50.
2615.90.6030	Niobium ores and concentrates	3,370	179	4,000	97	Canada 1,730, $23; Belgium 1,650, $18.
2615.90.6060	Tantalum ores and concentrates[3]	840,000	43,100	693,000	29,800	Australia 499,000, $20,300; Mauritius 105,000, $5,740; Congo (Kinshasa) 89,100, $3,720.
2825.90.1500	Niobium oxide	1,420,000	50,400	743,000	24,900	Brazil 522,090, $17,803; Thailand 121,000, $3,751; India 68,800, $1,934.
	Total ores, concentrates, and oxides	XX	93,700	XX	55,000	
	Ferroniobium:					
7202.93.4000	Silicon <0.4%	217,000	8,790	74,600	2,330	Germany 38,100, $1,550; Brazil 36,500, $783.
7202.93.8000	Other	11,100,000	259,000	8,210,000	181,000	Brazil 5,980,000, $129,000; Canada 2,160,000, $52,100.
	Total ferroniobium	11,300,000	268,000	8,280,000	184,000	
8112.92.4000	Unwrought, powders[4]	1,700,000	79,400	1,220,000	56,800	Brazil 729,000, $32,800; Russia 347,000, $14,200; Germany 109,000, $7,640.
	Total imports	XX	441,000	XX	295,000	

XX Not applicable.

[1]Table includes data available through June 21, 2021. Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Harmonized Tariff Schedule of the United States.

[3]Tantalum ores and concentrates may contain niobium.

[4]Niobium waste and scrap is included in HTS code 8112.92.0600, as well as other materials. Niobium other than powders, unwrought, and waste and scrap is included in HTS code 8112.99.9000, as well as other materials.

Sources: U.S. Census Bureau and U.S. Geological Survey.

TABLE 4

NIOBIUM: WORLD PRODUCTION OF MINERAL CONCENTRATES, BY COUNTRY OR LOCALITY[1, 2]

(Kilograms, niobium content)

Country or locality[3]	2016	2017	2018	2019	2020
Brazil, mineral concentrate:					
Columbite-tantalite	1,011,000	1,892,000	2,682,000	2,559,000	2,495,000
Pyrochlore	49,741,000	56,244,000	66,910,000	86,374,000	57,324,000
Total	50,752,000	58,136,000	69,592,000	88,933,000	59,819,000
Burundi, ore and concentrate[e]	6,200	28,000	43,000	38,000	23,000
Canada, pyrochlore concentrate	6,300,000	7,200,000	7,700,000 [e]	6,800,000 [e]	6,500,000 [e]
China, mineral concentrate	37,000	45,000	45,000	45,000 [e]	44,000 [e]
Congo, Kinshasa:[e]					
Cassiterite concentrate	120,000	180,000 [r]	160,000	180,000	260,000
Columbite-tantalite concentrate	420,000	380,000	400,000	230,000	300,000
Total	540,000	560,000 [r]	560,000	410,000	560,000
Ethiopia, columbite-tantalite concentrate[e]	16,000	22,000	26,000	7,000	6,900
Mozambique, columbite-tantalite concentrate	4,005	3,700 [e]	5,000 [e]	6,000 [e]	9,100
Nigeria, columbite-tantalite concentrate[e]	73,000	63,000	89,000 [r]	89,000 [r]	89,000
Russia, loparaite concentrates	439,209	452,771	467,451	460,877	448,251
Rwanda:[e]					
Cassiterite concentrate	32,000	42,000	42,000	35,000 [r]	26,000
Columbite-tantalite concentrate	160,000	220,000	210,000	170,000	130,000
Total	192,000	262,000	252,000	205,000 [r]	156,000
Uganda, ore and concentrate[e]	530	470	290 [r]	300	6,586
Grand total	58,400,000	66,800,000	78,800,000	97,000,000	67,700,000

[e]Estimated. [r]Revised.

[1]Table includes data available through September 20, 2021. All data are reported unless otherwise noted. Grand totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

[2]Figures for all countries and (or) localities represent marketable output.

[3]In addition to the countries and (or) localities listed, Australia, French Guiana, and Malaysia may have produced niobium mineral concentrates, but available information was inadequate to make reliable estimates of output.

TABLE 5

FERRONIOBIUM (FERROCOLUMBIUM): WORLD PRODUCTION, BY COUNTRY OR LOCALITY[1]

(Metric tons, niobium content)

Country or locality[2]	2016	2017	2018	2019	2020
Brazil	44,390	58,690	59,000 [e]	60,000 [e]	58,300 [e]
Canada	6,099	6,981	7,400 [e]	6,000 [e]	6,200 [e]
Russia[e]	80	240	290 [r]	400 [r]	390
Total	50,600	65,900	66,700	66,400 [r]	64,900

[e]Estimated. [r]Revised.

[1]Table includes data available through October 12, 2021. All data are reported unless otherwise noted; totals may include estimated data. Totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

[2]In addition to the countries and (or) localities listed, Austria, China, and Germany may have produced ferroniobium (ferrocolumbium), but available information was inadequate to make reliable estimates of output.