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NIOBIUM (COLUMBIUM) AND TANTALUM

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Niobium (Columbium) and Tantalum

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In 2008, U.S. niobium apparent consumption (measured in contained niobium) was 8,450 metric tons (t), a decrease of 6.3% compared with that of 2007; U.S. tantalum apparent consumption (measured in contained tantalum) was 629 t, a decrease of 2.4% compared with that of 2007. No domestic mine production of niobium or tantalum ore was reported.

The leading use of niobium was as an alloying element in high-strength low-alloy steel. The leading use of tantalum was in electronic capacitors.

Because the United States has no niobium or tantalum ore reserves, domestic supply has been a concern during every national military emergency since World War I. World niobium and tantalum ore resources and mining capacity are geographically concentrated in Brazil (niobium and tantalum) and Canada (niobium) in the Western Hemisphere and in Australia (tantalum) in the Eastern Hemisphere. World niobium and tantalum ore reserves are adequate to meet anticipated world demand in the short or long term. Material for recycling is the only domestic supply source of tantalum.

Domestic Data Coverage

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

Legislation and Government Programs

The Defense National Stockpile Center (DNSC) planned to dispose of niobium and tantalum materials under its fiscal year 2008 Annual Materials Plan (AMP) and announced the fiscal 2009 plan. The DNSC sold no niobium or tantalum materials in calendar year 2008. The DNSC's fiscal year 2009 AMP set maximum disposal goals for niobium and tantalum materials (niobium materials measured in contained niobium, and tantalum materials measured in contained tantalum) as follows: columbium metal, 9,072 kilograms (kg), and tantalum carbide, 3,629 kg (Defense National Stockpile Center, 2008a). DNSC suspended the sale of niobium and tantalum materials while it performed a congressionally directed review of the stockpile configuration (Defense National Stockpile Center, 2008b).

The DNSC exhausted its ferroniobium inventory in fiscal year 2001; niobium carbide in 2002; tantalum metal ingots in 2005; tantalum metal powder and tantalum pentoxide in 2006; and niobium and tantalum minerals in 2007.

Production

The major marketplace niobium materials are ferroniobium, nickel-niobium, and niobium metal, ore, and oxide. The major marketplace tantalum materials are tantalum metal, ore, and powder. In 2008, neither niobium nor tantalum domestic mine production was reported. The last significant mining of niobium and tantalum in the United States was during the Korean conflict, when increased military demand resulted in niobium and tantalum ore shortages. Ferroniobium is the most consumed niobium-containing material. Steel producers are the leading consumers of niobium-containing materials.

The Kougarok prospect, on the Seward Peninsula in Alaska, hosts significant tantalum resources in a lithium-fluorine granite (Hudson, 1998, p. 151–153; Navigator Exploration Corp., 2003, p. 2).

Consumption

Niobium and tantalum were consumed in the United States by the electronics and metallurgical industries. Niobium masteralloys—ferroniobium and niobium-nickel alloy—were consumed to produce steel and superalloys. About 75% of world niobium consumption was for the production of microalloyed steel (Companhia Brasileira de Metalurgia e Mineração, [undated]b). Tantalum was consumed to produce capacitors and superalloys. More than 70% of tantalum is consumed by the electronics industry, and most of that goes into making capacitors (Serjak and others, 2002). Gippsland Ltd. reported that about 50% of the world's 5 to 6 million pounds (2,000 to 3,000 t) of contained Ta_2O_5 annual production was used in electronic capacitors; 10%, in superalloys; and 10%, in corrosion resistant chemical equipment (Gippsland Ltd., 2008, p. 6–12, 22). Tantalum permits the production of reliable capacitors of high volumetric efficiency used in compact electronics, such as laptop computers and cellular telephones. Tantalum capacitors perform well in the temperature range of -55 °C to 125 °C, making them ideal for automotive electronics applications. Uranium and thorium are found with tantalum minerals and remain in the concentrate. As a result, some tantalum concentrate must be classified as a hazardous radioactive material when it is transported. The tantalum mining industry is small and specialized.

Prices

Niobium and tantalum materials are not openly traded. Purchase contracts are confidential between buyer and seller; however, trade journals report composite prices of tantalite based on interviews with buyers and sellers, and traders declare the value of niobium and tantalum materials that they import or export.

The price of many metals rose in early 2008 owing to increasing consumption fueled by economic growth in China and India followed by price decreases owing to the economic downturn associated with the world financial market. The price of tantalum was not as dramatically affected as the prices of

most other metals. The price of tantalite in 2008 remained unchanged (according to Platts Metals Week) or declined about 6% (according to Ryan's Notes). A sampling of the prices of various metals from January through December as reported by Platts Metals Week, showed that, while the price of tantalite was unchanged, the prices of other metals were on average about one-third what they had been at the beginning of the year. What was noteworthy about the price of tantalum in 2008 was that it did not change like those of most other metals.

Jeangrand (2005, p. 25) noted that "the tantalum market has been marked by long periods of stability, punctuated by very sharp price hikes created by a combination of strong demand and fears about shortage." Significant changes in tantalum price (yearend annual average price of tantalite) took place in 1980, 1988, and 2000. In 2000, price increased by a factor of 5, subsequently returning to historical values. The price surge was attributed to overordering (Minerals Bureau [South Africa], 2002, p. 14–15). Double and triple ordering of tantalum for capacitor production in late 2000 was done under a perceived looming supply shortage. Excessive ordering encourages the perception that consumption is increasing, which in turn creates the appearance that supply will fall short of demand. These perceptions can also contribute to price increases. The industry built up excessive inventories throughout the tantalum supply chain. The inventory reduction process was expected to remain a feature of the tantalum market for some time. The lack of change of the tantalite price in 2008 along with the closure of the Wodgina Mine (see Australia under World Review that follows) indicated that excess inventories were continuing to be worked off. World tantalum material stocks are not reported by the tantalum industry.

Foreign Trade

Niobium and tantalum material exports from and imports to the United States included ferroniobium and niobium chemicals, metal, ore, and oxide, and tantalum metal and ore. In 2008, the values of foreign trade of these niobium and tantalum materials were $156 million for exports and $524 million for imports.

The United States exported 781 t of niobium contained in niobium materials and imported 9,230 t of niobium contained in niobium materials (table 1). The United States exported 662 t of tantalum contained in tantalum materials and imported 1,290 t tons of tantalum contained in tantalum materials (table 2).

World Industry Structure

Brazil and Canada were the leading producers of niobium mineral concentrates; Australia, Brazil, Canada, China, and Mozambique were the leading producers of tantalum mineral concentrates. Tantalum-bearing tin slags, which are byproducts from tin smelting, principally from Asia, Australia, and Brazil, are another source of tantalum. The leading niobium ore and concentrate producers were Companhia Brasileira de Metalurgia e Mineração (CBMM) in Brazil and IAMGOLD Corporation (Niobec Mine) in Canada. The leading tantalum ore and concentrate producers were Talison Minerals Pty Ltd. (Wodgina Mine) in Australia, and Metalurg Group (Mibra Mine) and Grupo Paranapanema (Pitinga Mine) in Brazil. Other tantalum producers were Cabot Corp. (Tanco Mine) in Canada, Noventa Ltd. (Morropino Mine) in Mozambique, and Yichun Tantalum Co., Ltd. (Yichun Mine) in China.

The tantalum industry, traditionally shrouded in secrecy, comprises of (in order of material flow) a mining component that typically extracts ore and produces a concentrate, a processing segment that converts concentrate into an oxide or metal, a parts manufacturing segment that uses the oxide or metal material to produce such components as capacitors or superalloys, and a product manufacturing sector that uses the parts (such as capacitors) in electronic devices (such as cellular telephones) (Firman, 2008). World tantalum supply by source in 2007 was about 55% from primary production (mining), 20% from recycling, 17% from inventory, and 8% from tin slag (Talison Minerals Pty Ltd., 2007). Inventory components were the U.S. National Defense Stockpile (NDS) and surplus stocks that resulted from the 2001 "dot-com bubble." The inventory component of supply diminished because surplus stocks that were built up based on overoptimistic electronic industry growth expectations during the "dot-com bubble" were being dissipated. Sales tantalum ore and concentrate from the NDS stopped in 2006 when the last of that material was sold. World supply by source in 2008 was about 71% from primary production (mining), 20% from recycling, 2% from inventory, and 7% from tin slag (Wallwork, 2008). Tantalum world consumption was estimated to have grown at an average annual rate of 6% from about 1991 through 2006 (Ruffini, 2008).

Tantalum-bearing minerals were considered to be among the "conflict minerals" [minerals identified as a driving force for the conflict in the Congo (Kinshasa)] and production, trade, processing, and use of tantalum has come under international scrutiny (Enough Project Team and Grassroots Reconciliation Group, 2009). Transparency of material movement could contribute to the reduction of illicit material trade by permitting one to trace and audit the supply chain. Since those who trade in illicit minerals could reasonably be expected to hide the origin of their material, independent third-party verification is necessary. The tantalum "mineral fingerprint" that composes geologic age and chemical and mineral composition permits one to distinguish among various sources of columbite and tantalite ore (Melcher and others, 2008a, p. 2; 2008b).

World Review

Australia.—The Government of Western Australia reported that tantalite production was 680 t of contained tantalum pentoxide (Ta_2O_5) in 2008 compared with 538 t of contained Ta_2O_5 in 2007 (Government of Western Australia, Department of Mines and Petroleum, 2009, p. 19). Australia reported that, as of December 31, 2007, Joint Ore Reserves Committee (JORC)-compliant proven and probable ore reserves (as stated in company annual reports and reports to the Australian Stock Exchange) for tantalum to be 40,300 t of contained Ta_2O_5, and for niobium, 21,000 t of contained niobium pentoxide (Nb_2O_5) (Geoscience Australia, 2009, p. 4).

Talison Minerals Pty Ltd. suspended production at the Wodgina Mine, the world's leading producing operation of tantalum ore, owing to the global financial downturn and greater

market share going to central Africa (Talison Minerals Pty Ltd., 2008).

Capital Mining Ltd. reported finding niobium, among other metals, at a concentration of 80 grams per metric ton of niobium dioxide (NbO_2) at the Narraburra prospect about 12 kilometers (km) northeast of Temora, New South Wales. Capital planned to conduct laboratory-scale testing to determine the production potential of heavy minerals by gravity separation (Capital Mining Ltd., 2009, p. 10).

Queensland Gold and Minerals Ltd. prospected for niobium and tantalum at the Walwa prospect (147°45' E, 36°00' S) in Victoria State and for tantalum at Grant's Gully-Buchanan's Creek (143°25' E, 18°35' S) in Queensland State (Queensland Gold and Minerals Ltd., 2006).

Galaxy Resources Ltd. prospected for tantalum at Mount Cattlin in Western Australia State near the town of Ravensthorpe. Galaxy reported 24.8 million metric tons (Mt) of mineral resources at Mount Cattlin that was estimated to contain 6.62 million pounds of Ta_2O_5. Based on historical metallurgical test work, Galaxy expected recovery and grade of coarse tantalite from the jig circuit to offset lower values of both from the slimes (and possibly magnetic) circuits, so that a value of 65% was used for the global recovery of tantalite into final shipping concentrates, at a grade of 25% Ta_2O_5. Primary concentrate grade prior to final dressing was assumed to be 10% Ta_2O_5 (Galaxy Resources Limited, 2008, p. 2, 4).

Brazil.—The National Department of Mineral Production (DNPM) reported that CBMM, Anglo American of Brazil Ltda., and Grupo Paranapanema produced niobium and tantalum. Pereira and Andrade (2008) reported Brazilian niobium mine production of 129,348 t of contained Nb_2O_5 from reserves of 4,131,738 t of contained Nb_2O_5 in 2007. Heidrich (2007) reported that Brazil produced 215 t of contained Ta_2O_5 from reserves of 88,193 t of contained Ta_2O_5 in 2006.

CBMM mined niobium ore from the Barreiro carbonatite complex (19°40' S, 46°57' W) near Araxá, Minas Gerais State, and beneficiated the ore at the mine site by selectively extracting the pyrochlore minerals from which niobium oxide is separated (Filho and others, 2009). The deposit contained 450 Mt of ore reserves at an average grade of 2.5% to 3% Nb_2O_5 that could be mined by open pit methods. CBMM produced ferroniobium a production capacity of 90,000 metric tons per year (t/yr), high-purity ferroniobium and nickel-niobium with a production capacity of 3,000 t/yr, and niobium metal with a production capacity of 210 t/yr (Companhia Brasileira de Metalurgia e Mineração, [undated]a).

Anglo American Brazil [a subsidiary of Anglo American plc (Anglo)] mined pyrochlore from a carbonatite deposit. Catalão Mine (47°48' W, 18°08' S) comprised three open pit mines and a processing facility near the city of Catalão, Goiàs State. Anglo reported that Catalão mined 768,100 t of ore and processed 818,100 t of ore containing 11.1 kg of niobium per metric ton of ore to produce 4,600 t of contained niobium in 2008. JORC-compliant proved and probable reserves were 14.6 Mt at 1.19% Nb_2O_5 containing 174,000 t of niobium (Anglo American plc, 2009, p. 147, 164).

Mineração Taboca S.A. (a subsidiary of the Paranapanema S.A.) mined columbite at the Pitinga Mine (0°47'01" N, 60°04'43" W) in Presidente Figueiredo Municipality, Amazon State. Paranapanema reported that ferroniobiumtantalum alloy production was 1,540 t in 2008 compared with 1,929 t in 2007 (Paranapanema S.A., 2009, p. 7).

Angus & Ross plc prospected for tantalum at the Caiçara project in Rio Grande do Norte State (Angus & Ross plc, 2008, p. 37).

Canada.—Canada reported niobium mine production of 4,383 t of contained Nb_2O_5 and tantalum mine production of 49 t of contained Ta_2O_5 in 2008 compared with 4,337 t of contained Nb_2O_5 and 55 t of contained Ta_2O_5 in 2007. Niobium was produced in Quebec, and tantalum, in Manitoba (Natural Resources Canada, 2008, 2009).

Avalon Ventures Ltd. prospected for niobium and/or tantalum at its Thor Lake (about 62°06'20" N, 112°36' W) and Separation Rapids properties (Avalon Ventures Ltd., 2008, p. 3–5).

Commerce Resources Corp. prospected for niobium and/or tantalum at the Blue River (east of Quesnel, British Columbia), Eldor (south of Kuujjuaq, Quebec), and Carbo (north-east of Prince George, British Columbia) properties that host carbonatite deposits (Commerce Resources Corp., 2009). Commerce estimated that, at a cutoff grade of 150 grams per metric ton (g/t) Ta, the Upper Fir deposit contained 8.6 Mt of indicated resources at a grade of 209 g/t Ta_2O_5 and 1,373 grams of Nb_2O_5 content per metric ton of ore and inferred resources of 5.5 Mt at 208 grams of Ta_2O_5 content per metric ton of ore and 1,350 g/t Nb_2O_5 (Gorham, 2007, p. 39).

IAMGOLD mined niobium contained in pyrochlore mineral from the Saint-Honoré carbonatite deposit at the Niobec Mine 15 km northwest of Chicoutimi, Quebec (about 48°32' N, 71°09' W). Niobec had mill production capacity of 4,500 t/yr of niobium, ore from which Niobec produced Nb_2O_5 that was then converted to standard grade (66% niobium) ferroniobium by aluminothermic reduction. The mine shaft Niobec Mine was deepened its by 300 m to a depth of 850 m; IAMGOLD also worked on a paste backfill plant, planned for completion in 2010, and investigated mill expansion. IAMGOLD reported that niobium mine production in 2008 was 1.801 Mt of material mined, with 1.788 Mt ore milled at 0.62% Nb_2O_5 grade and 4,396 t of contained niobium produced compared with 4,300 t of contained niobium in 2007 and 613 t of contained niobium in 2006. IAMGOLD also reported 23.5 Mt of ore reserves containing 137,800 t of contained Nb_2O_5 proven plus probable reserves at an average grade of 0.59% Nb_2O_5 (IAMGOLD Corporation, 2009, p. 12–13, 41–42, 58–60, 148).

Niocan Inc. (2009, p. 2) sought a certificate of authority to open a mine on the Oka property from the Ministry of Sustainable Development, Environment and Parks.

Rocher Deboule Minerals Corporation (2008) owned the Lonnie Brent property, a niobium exploration property in north-central British Columbia. Taseko Mines Ltd. held the Aley niobium property, an exploration property in northern British Columbia. Development at the Aley property was put on hold because of economic conditions (Taseko Mines Limited, 2009, p. 9, 17).

China.—The leading tantalum mining areas were at Yichun, Jiangxi Province, and Nanping, Fujian Province (Fetherston, 2004, p. 78–79). TiChun Tantalum & Niobium Mine [formerly

called the 414 Mine (27°38'58.10" N 114°31'4.06" E) (Panoramio, 2008)] produced tantalum and niobium concentrate (Yichun Tantalum Co., Ltd., 2009).

King-Tan Tantalum Industry Co. Ltd. (formerly Gui-Family Tantalum-Niobium Ltd.) in Shishi town, Yifeng County, Jiangxi Province produced niobium and tantalum products (King-Tan Tantalum Industry Co. Ltd., 2009). Ningxia Non-ferrous Metals Smeltery, a state-owned enterprise, produced niobium and tantalum products (Ningxia Non-ferrous Metals Import & Export Corp., 2009).

Congo (Kinshasa).—Katanga, Kivu, Maniema, and Orientale Provinces in the eastern part of Congo (Kinshasa) host columbite-tantalite deposits known locally as coltan (Fetherston, 2004, p. 71). Shamika Resources Inc. (Canada) prospected for tantalum and niobium through Shamika Congo Kalehe SPRL (Shamika Resources Inc., 2009).

Egypt.—Tantalum Egypt JSC, comprise the Gippsland Ltd. (Australia) and the Government of Egypt, planned to mine tantalite from the Abu Dabbab and Nuweibi deposits. At Abu Dabbab (25°20'59.42" N, 34°13'30.07" E), mining was planned to start in 2010 at a rate of 2 million metric tons per year run-of-mine ore equivalent to 650,000 pounds per year contained Ta_2O_5 in concentrate and to ramp up production to 1 million pounds per year contained Ta_2O_5. Abu Dabbab reserves were 15.2 Mt at 260 g/t Ta_2O_5 proven and 15.0 Mt at 250 g/t Ta_2O_5 probable; resources were 15.2 Mt at 290 g/t Ta_2O_5 measured, 17.3 Mt at 250 g/t Ta_2O_5 indicated, and 12 Mt at 200 g/t Ta_2O_5 inferred. At Nuweibi (25°12'3.09" N, 34°29'56.15" E), resources were 48 Mt at 147 g/t Ta_2O_5 indicated, and 50 Mt at 138 g/t Ta_2O_5 inferred. H.C. Stark Group Gmbh (Germany) committed to buy 600,000 pounds per year of contained Ta_2O_5 for the first 10 years (Gippsland Ltd., 2008, p. 6–12, 22).

Outlook

Niobium.—The principal use for niobium was as an additive in steelmaking, mostly in the manufacture of microalloyed steels. The production of high-strength low-alloy steel was the leading use for niobium, and the trend for niobium consumption, domestically and globally, was expected to continue to closely follow that of steel production, as the steel industry is estimated to account for as much as 90% of niobium consumption. (Additional information about the steel industry can be found in the Iron and Steel chapter of the USGS Minerals Yearbook, volume I, Metals and Minerals.) Demand for niobium, however, does not mirror trends in overall steel production, as only 10% of steel products contain niobium. The leading nonsteel use of niobium was in superalloys for, among other applications, aircraft engines.

Tantalum.—The leading applications for tantalum were in alloys, carbides, and oxides that are used in the chemical, electronics, and metallurgical industries. Tantalum consumption was expected to change as its use in these industries changes. Tantalum demand significantly increased in the 1950s when the U.S. Government decided to purchase 6,800 t of tantalum in various forms (Jeangrand, 2005, p. 22–23, 25, 67). The purchase for stockpiling permitted the development of industrial-scale commercial mining that began to replace artisanal mining, a trend that continues today. Electronic capacitor applications emerged as the leading consumer of tantalum in the 1960s and have since played an important role in tantalum use.

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TABLE 1
SALIENT NIOBIUM STATISTICS[1]

		2004	2005	2006	2007 [e]	2008 [e]
United States:						
Government stockpile releases, Niobium (Nb) content[2, 3]	metric tons	90	152	156	--	--
Exports, Nb content[4]	do.	276	337	561	1,100	781
Imports for consumption:						
Mineral concentrates, Nb content	do.	167	142	120	109	134
Niobium metal, gross weight[5]	do.	940	1,380	1,450	864	1,130
Niobium oxide, Nb content[e]	do.	633	661	760	744	852
Ferroniobium, Nb content[e]	do.	5,170	5,430	8,150	8,400	7,120
Reported consumption, Nb content						
Raw materials	do.	W	W	W	W	W
Ferroniobium and nickel niobium[e]	do.	4,220	4,600	5,050	6,510	6,000
Apparent consumption, Nb content	do.	6,730	7,430	10,100	9,020	8,450
Prices,[6] Ferroniobium[7] Nb content	dollars per kilogram	14.5	14.5	NA	NA	NA
Value:[8]						
Niobium ores and concentrates (gross weight)	do.	6.96	9.70	13.71	22.55	26.70
Niobium oxide (gross weight)	do.	15.30	14.12	14.07	17.64	25.65
Ferroniobium (gross weight)	do.	8.72	8.66	9.13	13.88	21.29
World, production of niobium-tantalum concentrates, Nb content	metric tons	41,900	60,300	51,200	60,400	62,900

[e]Estimated. do. Ditto. NA Not available. W Withheld to avoid disclosing company proprietary data. -- Zero.

[1]Data are rounded to no more than three significant digits, except prices.

[2]Release is the decrease of uncommitted inventory relative to the previous calendar year.

[3]To estimate Nb content, it was assumed that natural tantalum and synthetic tantalum-niobium ores and concentrates are 16% Niobium pentoxide (Nb_2O_5) niobium ores and concentrates are 30% Nb_2O_5; and Nb_2O_5 is 69.9% Nb.

[4]Includes natural and synthetic niobium ore and concentrates, niobium oxide, niobium ferroalloy, and unwrought niobium metal and alloys.

[5]Includes niobium and articles made of niobium.

[6]The published price for columbite ore was discontinued in 2001 at a range of $5.50 to $7.00 per pound of Nb_2O_5 content. The published prices of Brazilian and Canadian pyrochlore were discontinued in 1981 and 1989, respectively. Price is time-weighted average as reported in trade journals.

[7]Standard (steelmaking) grade. American Metal Market discontinued reporting the price of vacuum grade ferroniobium in 2002 and standard grade in 2005.

[8]Mass-weighted average value of imported plus exported materials.

TABLE 2
SALIENT TANTALUM STATISTICS

		2004	2005	2006	2007 [e]	2008 [e]
United States:						
Government stockpile releases,[1] Tantalum (Ta) content[2]	metric tons	127	210	289	--	--
Exports:						
Tantalum ores and concentrates,[3] Ta content	do.	223	174	247	146	96
Tantalum metal, gross weight	do.	504	567	590	207	390
Tantalum and tantalum alloy powder, gross weight	do.	257	242	112	158	176
Imports for consumption:						
Mineral ores and concentrates, Ta content	do.	451	382	322	294	357
Tantalum metal and tantalum-bearing alloys,[4] gross weight	do.	1,090	1,240	835	861	934
Tin slag	do.	NA	NA	NA	NA	NA
Reported consumption, raw materials Ta content	do.	W	W	W	W	W
Apparent consumption, Ta content	do.	679	852	498	644	629
Prices, tantalite[5], Tantalum pentoxide (Ta_2O_5) content	dollars per kilogram	66	77	72	80	87
Value,[6] tantalum ores and concentrates, gross weight	do.	35	31	33	43	49
World, production of niobium-tantalum concentrates, Ta content	metric tons	1,520	1,470	964	815	1,170

[e]Estimated. do. Ditto. NA Not available. W Withheld to avoid disclosing company proprietary data. -- Zero.

[1]Release is the decrease in uncommitted inventory relative to the previous calendar year.

[2]To estimate Ta content, it was assumed that natural niobium and synthetic niobium-tantalum ores and concentrates are 32% Ta_2O_5; tantalum ores and concentrates are 37% Ta_2O_5; and Ta_2O_5 is 81.9% tantalum.

[3]Includes natural and synthetic tantalum ore and concentrates.

[4]Includes unwrought powders, unwrought alloys and metals, waste and scrap, and wrought alloys and metal.

[5]Time-weighted average price per Ta_2O_5 content as reported in trade journals. Includes Metal Bulletin, Platts Metals Week, and Ryan's Notes. (Metal Bulletin price discontinued in May 2008).

[6]Mass-weighted average value of imported plus exported materials.

TABLE 3
REPORTED CONSUMPTION, BY END USE, INDUSTRY STOCKS OF FERRONIOBIUM AND NICKEL NIOBIUM AND GOVERNMENT STOCKS BY MATERIAL IN THE UNITED STATES[1]

(Metric tons of niobium and tantalum content)

End use:	2007	2008
Steel:		
Carbon	1,730	1,450
Stainless and heat-resisting	843	674
Full alloy	(2)	(2)
High-strength low-alloy	928	852
Electric	(2)	(2)
Tool	(2)	(2)
Unspecified	1,599	1,592
Total	5,100	4,570
Superalloys	1,400	1,420
Alloys (excluding steels and superalloys)	3	16
Miscellaneous and unspecified	--	--
Grand total	6,510	6,000
Stocks, December 31:		
Consumer	623	338
Producer[3]	W	W
Total	623	338
National Defense Stockpile, total uncommitted inventory by material:[4]		
Niobium:		
Concentrates	--	--
Carbide powder	--	--
Ferroniobium	--	--
Metal ingots	10.1	10.1
Total	10.1	10.1
Tantalum:		
Minerals	--	--
Carbide powder	1.73	1.73
Metal:		
Capacitor grade	--	--
Ingots	--	--
Oxide	--	--
Total	1.73	1.73

W Withheld to avoid disclosing company proprietary data. -- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Included with "Steel, unspecified."
[3]Ferroniobium only.
[4]National Defense Stockpile disposed of the remaining inventory of niobium concentrates, tantalum minerals oxide and capacitor grade metal in 2006, tantalum metal ingot in 2006; and ferroniobium and niobium carbide in 2001.

TABLE 4
U.S. FOREIGN TRADE IN NIOBIUM AND TANTALUM METAL AND ALLOYS, BY CLASS[1]

HTS Code	Class	2007 Gross mass (kilograms)	2007 Value (thousands)	2008 Gross mass (kilograms)	2008 Value (thousands)	Principal destinations and sources in 2008 (gross mass in kilograms and values in thousand dollars)
	Exports:					
	Niobium:					
2615.90.6030	Ores and concentrates	163,000	$3,670	62,800	$2,010	United Kingdom 18,700, $590; Hungary 15,400, $108; Finland 8,690, $501; Germany 5,970, $317; Sweden 4,670, $418; Peru 3,070, $21; Japan 2,750, $12; France 1,567, $16; India 1,429, $10, Australia 400, $3; Canada 50, $3; Italy 25, $7.
2825.90.1500	Oxide	--	--	--	--	
7202.93.0000	Ferroniobium	1,580,000	17,200	1,130,000	12,500	Canada 708,000, $7,820; France 315,000, $3,460; United Kingdom 62,500, $691; Netherlands 16,800, $185; Peru 13,800, $128; China 4,440, $23; Philippine 3,410, $37; Brazil 3,110, $34;
8112.92.4000	Unwrought and powders	--	--	--	--	Japan 2,601, $29; Mexico 2,070, $37; Taiwan, 1,530, $17; Austria 532, $7; Germany 252, $4.
	Tantalum:					
2615.90.3000	Synthetic concentrates	151,000	347	110,000	302	Brazil 107,000, $264; Spain 1,990, $9; United Kingdom 568, $5; Italy 351, $20; Germany 307, $3.
2615.90.6060	Ores and concentrates	209,000	1,240	167,000	2,490	Brazil 151,000, $849; Czech Republic 14,300, $1,610; United Kingdom 1,100, $13; Japan 92, $6; Spain 22, $4.
8103.20.0030	Unwrought, powders	158,000	54,500	176,000	64,600	Mexico 109,000, $40,100; Israel 20,400, $6,670; Germany 16,400, $7,050; Czech Republic 8,740, $4,010; Portugal 6,930, $2,910; Kazakhstan 4,150, $488; Sweden 3,920, $647; Netherlands 2,000, $209.
8103.20.0090	Unwrought, alloys and metal	5,990	1,100	39,000	4,390	Belgium 18,000, $1,150; Finland 9,980, $750; Malaysia 7,750, $1,530; Spain 1,130, $218.
8103.30.0000	Waste and scrap	105,000	6,620	247,000	20,800	Hong Kong 91,000, $3,560; Kazakhstan 88,000, $8,790; Germany 25,200, $2,390.
8103.90.0000	Wrought	95,900	43,100	104,000	49,300	Mexico 30,100, $15,700; Japan 23,100, $8,940; Germany 16,900, $7,760; France 8,010, $3,310; Kazakhstan 6,920, $2,270; Thailand 5,100, $2,220; Korean, Republic of 2,280, $1,530; United Kingdom 1,710, $958; Netherlands 1,630, $589.
	Total, exports	XX	128,000	XX	156,000	
	Imports for consumption:					
	Niobium:					
2615.90.6030	Ores and concentrates	800	26	15,600	87	All from China.
2825.90.1500	Oxide	1,060,000	18,800	1,220,000	31,300	Brazil 797,000, $20,100; Russia 231,000, $3,050; Germany 84,400, $4,100; China 57,500, $3,250; Estonia 45,000, $553.
	Ferroniobium:					
7202.93.4000	Silicon < 0.4%	1,100,000	19,600	258,000	8,290	Brazil 190,000, $6,290; Germany 48,200, $1,670; Canada 19,600, $333.
7202.93.8000	Other	11,800,000	165,000	10,700,000	237,000	Brazil 9,800,000, $218,000; Canada 859,000, $18,900; Germany 4,000, $105.
	Total, ferroniobium	12,900,000	184,000	11,000,000	245,000	
8112.92.4000	Unwrought, and powder[3]	864,000	26,100	1,130,000	47,500	Brazil 968,000, $40,000; Germany 79,700, $3,650; Estonia 75,400, $3,490; China 1,640, $299.
	Tantalum:					
2615.90.3000	Synthetic concentrates	2,330	12	3,620	21	Russia 3,600, $18,000; China 20, $3,000.
2615.90.6060	Ores and concentrates	967,000	49,700	1,160,000	63,100	Australia 774,000, $49,900; Canada 193,000, $7,340; Mozambique 179,000, $5,000; China 9,900, $653.
8103.20.0030	Unwrought powders	214,000	55,400	230,000	52,800	Germany 65,900, $15,700; Thailand 56,700, $16,100; China 52,000, $10,300; Japan 28,900, $9,350.
8103.20.0090	Unwrought, alloys and metal	142,000	20,800	194,000	34,600	Kazakhstan 110,000, $21,000; Thailand 56,700, $16,100; China 49,100, $8,280; Germany 14,600, $2,420; Estonia 10,000, $1,480; Netherlands 5,080, $822; Austria 4,210, $682.

See footnotes at end of table.

TABLE 4—Continued

U.S. FOREIGN TRADE IN NIOBIUM AND TANTALUM METAL AND ALLOYS, BY CLASS[1]

8103.30.0000	Waste and scrap	425,000	18,600	410,000	26,000	Mexico 98,000, $2,200; China 62,000, $2,870; Germany 61,200, $5,100; Portugal 50,000, $1,160; Japan 31,000, $1,810; Estonia 28,900, $5,110; United Kingdom 27,300, $2,100; Hong Kong 13,400, $1,600.
8103.90.0000	Wrought	80,800	17,900	101,000	23,200	China 29,500, $9,760; Mexico 28,900, $2,510; Kazakhstan 28,800, $6,560; Germany 6,670, $1,510; Austria, 2,730, $1,640; France 1,820, $236; Japan 1,660, $457.
	Total, imports	XX	391,000	XX	524,000	

XX Not applicable. -- Zero.

[1]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]Niobium waste and scrap is included in 8112.92.0600 along with other materials. Niobium other than unwrought; waste and scrap; and powders are included in 8112.99.9000 along with other materials.

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

TABLE 5

U.S. IMPORTS FOR CONSUMPTION OF TANTALUM ORES AND CONCENTRATES, BY COUNTRY[1]

	2007		2008	
Country	Gross mass (kilograms)	Value (thousands)	Gross mass (kilograms)	Value (thousands)
Australia	708,000	$42,000	774,000	$49,900
Canada	209,000	6,350	193,000	7,340
China	1,450	94	9,900	653
France	--	--	64	3
Mozambique	48,100	1,290	179,000	5,000
Nigeria	--	--	6,110	206
Total	967,000	49,700	1,160,000	63,100

-- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

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

TABLE 6

NIOBIUM AND TANTALUM: WORLD PRODUCTION OF MINERAL CONCENTRATES, BY COUNTRY[1, 2]

(Metric tons)

Country[5]	Gross mass[3]					Niobium content[4]					Tantalum content[4]				
	2004	2005	2006	2007	2008[e]	2004	2005	2006	2007	2008[e]	2004	2005	2006	2007	2008[e]
Australia, columbite-tantalite[6]	3,610 [e]	3,820 [r, e]	2,140 [e]	1,630 [r, e]	2,060	--	--	--	--	--	807 [r]	854 [r]	478 [r]	441 [r]	557 [7]
Brazil:															
Nb minerals[8, 9]	168,010	247,023	206,550	245,766	246,000	23,779 [r]	39,162 [r]	48,129	57,267	58,000	--	--	--	--	--
Ta minerals[6, 10]	780 [e]	792 [e]	645 [e]	650 [e]	650	--	--	--	--	--	213 [r]	216 [r]	176	180 [e]	180
Burundi	23	43	16	52 [r]	52	5	8	3	1 [r]	1	5	9	3	9 [r]	9
Canada:															
Nb minerals[9]	10,800 [e]	11,100 [e]	12,500 [e]	12,900 [e]	13,150 [7]	3,599 [r]	3,710 [r]	4,157 [r]	4,337 [r]	4,383 [7]	--	--	--	--	--
Ta minerals[6, 10]	253	282	249	201	150	--	--	--	--	--	57	63	56	45	40
Congo (Kinshasa), columbite-tantalite[e, 11]	74 [7]	124 [7]	52 [7]	267 [r, 7]	380	17	28	12	61 [r]	86	20	33	14	71 [r]	100
Ethiopia, tantalite	71	93	109	120	120	7	9	11	12 [e]	12	45	59	70	77 [e]	77
Mozambique	712 [7]	281 [7]	80 [7]	196 [r, 7]	250	87	34	10	24 [r]	31	205	81	23	61 [r]	77
Namibia[e]	30	--	--	--	--	(12)	--	--	--	--	11	--	--	--	--
Nigeria, columbite-tantalite	100	110 [r, ε]	900 [r, ε]	450 [r, e]	500	40	45 [r]	387 [r]	180 [r]	194	5	5 [r, ε]	10 [r, ε]	20 [r, ε]	25
Rwanda	220	276	188	490 [r]	490	72 [r, ε]	91 [r, ε]	62 [r, ε]	160 [r, ε]	160	45 [r, ε]	57 [r, ε]	42 [r, ε]	100 [r, ε]	100
Uganda[e]	(12) [7]	(12)	(12)	(12)	(12)	(12) [7]	(12)	(12)	(12)	(12)	(12) [7]	(12)	(12)	(12)	(12)
Zimbabwe[e]	50	--	NA	-- [r]	--	-- [r]	--	-- [r]	-- [r]	--	14	--	NA	-- [r]	--
Total	185,000	264,000	223,000	263,000 [r]	264,000	27,600 [r]	43,100 [r]	52,800 [r]	62,000 [r]	62,900	1,430 [r]	1,380 [r]	872 [r]	1,000 [r]	1,170

[e]Estimated. [r]Revised. NA Not available. -- Zero.

[1]World totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

[2]Excludes production of columbium and tantalum contained in tin ores and slags. Table includes data available through July 1, 2009.

[3]Gross mass is mass of concentrate before metal is extracted.

[4]Content is mass of metal produced. Nb_2O_5 is 69.904% niobium. Ta_2O_3 is 81.897% tantalum.

[5]In addition to the countries listed, Bolivia, China, French Guiana, Kazakhstan, and Russia also produce, or thought to produce, niobium and tantalum mineral concentrates, but available information is inadequate to make reliable estimates of output levels.

[6]Tantalum production reported in Ta_2O_5 content converted to tantalum content. Gross mass is concentrate assumed to be one-third Ta_2O_5.

[7]Reported figure.

[8]Niobium concentrate production reported in Nb_2O_5 content converted to niobium content. Gross mass is concentrate assumed to be one-third Nb_2O_5.

[9]Includes columbite and pyrochlore.

TABLE 6—Continued

NIOBIUM AND TANTALUM: WORLD PRODUCTION OF MINERAL CONCENTRATES, BY COUNTRY[1, 2]

[10]Includes djalmaite and tantalite.

[11]Reported data includes the North and South Kivu Provinces.

[12]Less than ½ unit.

TABLE 7
FERRONIOBIUM (FERROCOLUMBIUM): WORLD PRODUCTION, BY COUNTRY

(Metric tons, Nb content)

Country[1]	2004	2005	2006	2007	2008[e]
Brazil	25,169	38,819	41,566	52,442	52,500
Canada[e]	3,559	3,710	4,157	4,337	4,385 [2]
India[e]	40	43	43	43	43
Russia	--	--	--	80	80
United States	NA	NA	NA	NA	NA
Total	28,800	42,600	45,800	56,900	57,000

[e]Estimted; estimated data are rounded to no more than three significant digits; may not add to totals shown.
NA Not available. -- Zero.

[1]In addition to the countries listed, Austria, China, and Germany are thought to have produced ferroniobium (ferrocolumbium), but production information is inadequate for the formulation of estimates of output levels.
[2]Reported figure.