



2016 Minerals Yearbook

TANTALUM [ADVANCE RELEASE]

TANTALUM

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In 2016, U.S. apparent consumption of tantalum (measured in contained tantalum) was 458 metric tons (t), 22% less than that revised of 2015 (table 1). No domestic mine production of tantalum ore was reported. In 2016, the United States exported 604 t of tantalum contained in tantalum-bearing metal, alloys, ores, and concentrates (8% less than that of 2015). In the same period, the United States imported 1,060 t of tantalum contained in alloys, metals, ores, and concentrates (15% less than that of 2015) (table 1). The principal uses of tantalum were in electronic capacitors and in superalloys for aircraft engines and turbines. Tantalum content of world mine production was 1,220 t in 2016, a slight increase compared with that of the previous year (table 4).

Because tantalum resources in the United States are of low grade and not commercially recoverable at current prices, domestic supply has been a concern. World tantalum resources and mining capacity are concentrated in Australia, Brazil, Canada, China, Congo (Kinshasa), Nigeria, and Rwanda. World tantalum reserves are adequate to meet anticipated world consumption. Materials for recycling and stocks are the only domestic supply sources of tantalum.

Traded tantalum materials included chemicals, metal, potassium hepta fluorotantalate (commercially known as K-salt), residue, scrap, slag, and tantalum ores and concentrates. K-salt and tantalum pentoxide do not have unique Harmonized Tariff Schedule of the United States (HTS) codes. As a result, a potentially significant part of tantalum material trade is undocumented. There is no unique 6-digit HTS code for tantalum ores and concentrates. As a result, world trade of tantalum ores and concentrates cannot reliably be documented. The absence of unique HTS codes for these tantalum materials eliminates international movement transparency for those materials and may thereby facilitate covert movement of illicit materials.

Legislation and Government Programs

The Defense Logistics Agency Strategic Materials (DLA Strategic Materials), U.S. Department of Defense, did not designate tantalum materials for disposal under its fiscal year 2017 Annual Materials Plan; however, the DLA Strategic Materials assigned 1.71 t of tantalum carbide powder for potential upgrade and (or) disposal (Defense Logistics Agency Strategic Materials, 2016a). The DLA Strategic Materials designated a ceiling quantity of 15.4 t of tantalum for potential acquisition (Defense Logistics Agency Strategic Materials, 2016b), which was later revised to 21.2 t (Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, 2017, p. 12).

The Department of Labor identified coltan, a niobium- and tantalum-containing ore, from Congo (Kinshasa) as a good produced by child labor and forced labor (U.S. Department of Labor, 2016, p. 30, 32).

Production

The leading marketable tantalum materials are tantalum metal (unwrought and wrought alloys, metal, and powder), ore, and scrap. In 2016, no domestic tantalum mine production was reported. National tantalum resources are of low grade, some are mineralogically complex, and most are not commercially recoverable. Companies in the United States produced tantalum alloys, compounds, and metal from imported tantalum-containing materials and from foreign and domestic scrap, but the available information was inadequate for a reliable estimate of output.

Consumption

Domestic consumption of tantalum materials was developed by the U.S. Geological Survey using the “Columbium (Niobium) and Tantalum,” “Consolidated Consumers,” and “Specialty Ferroalloys” surveys. For tantalum materials, one consumer responded to the “Columbium (Niobium) and Tantalum” canvass, one responded to the “Specialty Ferroalloys” canvass, and 26 responded to the “Consolidated Consumers” canvass. In 2016, the steel industry accounted for about 80% of reported consumption.

ATI Specialty Alloys and Components, Global Advanced Metals Pty Ltd (GAM), H.C. Starck Inc., and Kemet Corp. consumed tantalum feed materials to produce intermediate tantalum materials used in industrial manufacturing processes and products.

Prices

Tantalum materials were not openly traded. Purchase contracts were confidential between buyer and seller; however, trade journals reported composite prices of tantalite based on interviews with buyers and sellers, and traders declared the value of tantalum materials that they imported or exported (table 1). In 2016, the annual average price of tantalite ore was \$193 per kilogram of contained tantalum pentoxide (Ta_2O_5), unchanged from that of 2015. The average monthly tantalite ore price in 2016 was \$193 per kilogram of contained Ta_2O_5 in January, where it remained through December (CRU Group, 2017).

Foreign Trade

Tantalum material exports from and imports to the United States included tantalum metal, ores, powders, and waste and scrap. In 2016, the United States exported tantalum materials valued at \$154 million (about 12% less than that of 2015) and imported tantalum materials valued at \$197 million (about 28% less than that of 2015) (table 2).

World Industry Structure

Tantalum global primary production from tantalum concentrates, tin slags, and other concentrates was estimated at about 1,220 t of contained tantalum in 2016. Congo (Kinshasa) and Rwanda were the leading producers of tantalum mineral concentrates (table 4). Tantalum-bearing tin slags, which are byproducts from tin smelting, principally from Asia, Australia, and Brazil, were another source of tantalum. The leading tantalum ore and concentrate producers were artisanal mining operations in Congo (Kinshasa) and Rwanda, and vertically integrated mining operations of AVX Corp. and Kemet Corp. in Congo (Kinshasa).

In 2015, the most recent year for which data were available, capacitors accounted for 33% of global tantalum consumption; carbides, 8%; chemicals, 11%; mill products, 9%; sputtering targets, 17%; and superalloys, 22% (Roskill Information Services Ltd., 2016, p. 1, 18–21, 108–110).

World Review

Australia.—In June, Mineral Resources Ltd. acquired from GAM the Wodgina Mine and its associated assets, including the power station, camp, and mineral processing equipment. GAM retained the mineral rights to the mine's substantial 40,000-t tantalum reserves (Mineral Resources Ltd., 2016). GAM continued to process and concentrate crude tantalum material at its Greenbushes Mine in Western Australia (Global Advanced Metals Pty Ltd, 2016).

General Mining Corp. and Galaxy Resources Ltd. planned to restart production at the Mt. Cattlin spodumene and tantalum project near Ravensthorpe under a 3-year lease agreement. Galaxy put Mt. Cattlin on care-and-maintenance status in July 2012. The operation redesigned its mineral processing to achieve a throughput of 800,000 metric tons per year (t/yr) and to increase yield of tantalum concentrate to 70% to 75% from 50% to 55%, which would produce approximately 79 t/yr of contained Ta₂O₅ (Galaxy Resources Ltd., 2016).

Pilbara Minerals Ltd. announced that the commissioning process for their Tabba Tabba tantalum project was suspended indefinitely. Engineering assessments found that areas of the Tabba Tabba plant required additional modification and rectification before the plant could run at optimal levels (Pilbara Minerals Ltd., 2016a, p. 22). Pilbara had begun the definitive feasibility study for their Pilgangoora lithium-tantalum project, and in December the Western Australian Department of Mines and Petroleum granted them the main mining lease for Pilgangoora (Pilbara Minerals Ltd., 2016a, p. 2; 2016b). Pilgangoora had indicated and inferred resources of 33 million metric tons (Mt) grading 0.022% tantalum.

Canada.—Frontier Lithium Inc., formerly Houston Lake Mining Inc., completed a revised NI 43-101 resource estimate for the Pakeagama Lake property, also known as the PAK lithium project, and selected Nordmin Engineering Ltd. to prepare a prefeasibility study (Frontier Lithium Inc., 2016a; 2016b, p. 1–5).

Congo (Kinshasa).—Congo (Kinshasa) reported that more than 70% of its mines were considered to be conflict free. The Government of Congo (Kinshasa) planned to grow the mining sector by speeding up the extension and validation of mining sites, taxing processing plants that do not hold mining rights,

determining prices on a weekly basis, and improving rail service (Chambre des Mines, 2016, p. 9).

United Materials Congo SARL (UMC) signed agreements with La Coopérative Minière pour le Développement Intégré du Congo (CMDIC), La Coopérative Minière LUBI (CML), and La Coopérative Minière pour la Production Artisanale au Katanga (COMIPAK). Under the agreements, CMDIC, CML, and COMIPAK will become subcontractors to UMC in artisanal mining of tantalum in the Province of Katanga, north Congo (Kinshasa). UMC, a wholly owned subsidiary of Tantalex Resources Corp. (Canada), will hold exclusive rights to the entirety of the Ta₂O₅ produced by CMDIC, CML, and COMIPAK (Tantalex Resources Corp., 2016a–c).

Ethiopia.—The Ethiopian Minerals, Petroleum and Bio-Fuel Corporation (EMPBC) began operating in June. It was established by the Ethiopian Government to replace the Ethiopian Mineral Development Share Company, a Government-owned mining operation, and to engage in exploration, development, and trading of petroleum; exploration and development of minerals; and development of biofuels. In addition, EMPBC sought an international partner with the technological and financial capability to jointly develop a manufacturing plant to process tantalum concentrate; to produce tantalum value-added products within Ethiopia, such as foil, powder, and wire; and to recover lithium that is associated with the tantalum (Bekele, 2016; Precise Ethiopia, 2016).

Mozambique.—Highland African Mining Co., previously known as Noventa Ltd., is the owner of the Marropino and Morrua deposits, which were acquired in 2003. The Marropino Mine produced an estimated 91 t of Ta₂O₅ in 2012 but has been closed since 2013 owing to the radioactivity level of the material. Production from tailings and soft rock at Morrua has an output capacity of 90 t/yr (Roskill Information Services Ltd., 2016, p. 80).

Namibia.—African Tantalum Pty. Ltd. (75% owned by Kennedy Ventures plc) recommissioned the Tantalite Valley Mine (TVM) near Warmbad, Karas District, Namibia. Following upgrades to plant equipment, TVM returned to commercial production processing 10,500 metric tons per month (t/mo) of ore. Its first shipment, containing 1.6 t of tantalite concentrate, was delivered to its offtake partner on schedule. African Tantalum planned to continue upgrading its TVM plant and equipment, with the goal of increasing the recovery of fine tantalite and reaching full production at a mining rate of 15,000 t/mo by midyear 2017 (Kennedy Ventures plc, 2016).

Rwanda.—The Government of Rwanda signed agreements with Tri Metals Mining Ltd. to mine tantalum in Biseseo, Karongi District (Reuters Africa, 2016). Tri Metals is a subsidiary of Mawarid Mining LLC, a wholly owned subsidiary of MB Holding Company LLC registered in the Sultanate of Oman.

South Africa.—Australian Vanadium Ltd. (AVL) acquired interest in the Blesberg lithium-tantalum project near Springbok in Northern Cape Province. AVL planned to drill the Noumas I pegmatite (the location of the Blesberg Mine), map the sample data, and evaluate the potential tantalum economic minerals (Australian Vanadium Ltd., 2017, p. 1–2).

Outlook

World tantalum new supply (from mine concentrates, slags, and synthetic concentrates) was forecast to increase to 1,790 t by 2020 (Roskill Information Services Ltd., 2016, p. 1, 18–21, 108–110). In addition to new supply, tantalum can also be supplied from recycled material. The amount of recycling is dependent on price; as the price increases for tantalum, recycling increases and vice versa.

Tantalum is a potential byproduct from some lithium deposits. The increased need for lithium, resulting from its increased use in batteries, suggests that new lithium mining operations could come into production in the next few years and also could become a source of tantalum as a byproduct (Benchmark Mineral Intelligence, 2015). Lithium from brine (the lowest cost source) is expected to meet the market need; however, lithium from some pegmatite deposits (from spodumene) can be brought into production in a much shorter timeframe than that from brine. In recent years, spodumene production has doubled in response to market needs. Lithium deposits with potential for tantalum production included Mt. Marion (forecasted to start production in 2016), Mt. Cattlin (2017), Pilgangoora 1 (2018), Pilgangoora 2 (2018), and Wodgina (2018) in Australia, and Pakeagama (2018) in Canada. Tantalum concentrates also could be produced from spirals or magnetic separation used to concentrate lithium minerals (Tamlin, 2017).

As microelectronic use increases, tantalum sputtering target use is also expected to increase, assuming no significant technological change. Tantalum alloys have high strength and high-temperature resistance, making them useful in jet- and rocket-engine applications. High corrosion resistance makes tantalum alloys and tantalum coatings useful in chemical process applications or other severe industrial applications. Thus, tantalum use in superalloys and tantalum alloys should follow trends in aircraft jet engine production and chemical plant construction and renovation. Tantalum carbide is durable and temperature resistant and is used in cutting tools, machine tool bits, and teeth in construction, drilling, and mining equipment. As such, tantalum use would be expected to change in response to changes in construction, drilling, metal manufacturing, and mining activities (Zogbi, 2012, p. 42–47, 51, 64, 66, 72).

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TABLE 1
SALIENT TANTALUM STATISTICS¹

| | | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|----------------------|--------------------|------------------|--------------------|--------------------|-------|
| United States: | | | | | | |
| Exports: | | | | | | |
| Niobium ores and concentrates, gross quantity | metric tons | 31 | 110 | 60 | 73 | 14 |
| Synthetic ores and concentrates, gross quantity | do. | 209 | 61 | 200 | 138 | 379 |
| Tantalum ores and concentrates, gross quantity | do. | 202 | 204 | 225 | 98 | 162 |
| Tantalum-containing ores and concentrates, ² Ta content | do. | 120 | 110 | 140 | 85 | 150 |
| Tantalum, unwrought, Ta content ³ | do. | 136 | 161 | 247 | 235 | 223 |
| Tantalum, waste and scrap, Ta content ³ | do. | 235 | 521 | 285 | 280 | 171 |
| Tantalum, wrought, Ta content ³ | do. | 81 | 54 | 57 | 57 | 58 |
| Imports for consumption: | | | | | | |
| Niobium ores and concentrates, gross quantity | metric tons | 11 | 8 | 2 | -- | 1 |
| Tantalum ores and concentrates, gross quantity | do. | 261 | 655 | 897 | 730 | 675 |
| Tantalum-containing ores and concentrates, ² Ta content | do. | 82 | 200 | 270 | 220 | 210 |
| Tantalum, unwrought, Ta content ³ | do. | 343 | 310 | 292 | 416 | 320 |
| Tantalum, waste and scrap, Ta content ³ | do. | 515 | 527 | 625 | 565 | 489 |
| Tantalum, wrought, Ta content ³ | do. | 70 | 68 | 44 | 41 | 48 |
| Apparent consumption, Ta content | do. | 434 | 263 ^r | 508 | 586 ^r | 458 |
| Price, tantalite, ⁴ Ta ₂ O ₅ content | dollars per kilogram | 239 | 260 | 221 | 193 | 193 |
| Value, ⁵ tantalum ores and concentrates, gross quantity | do. | 45 | 68 | 69 | 65 | 53 |
| World, production of tantalum concentrates, Ta content | metric tons | 1,020 ^r | 1,290 | 1,430 ^r | 1,200 ^r | 1,220 |

^rRevised. do. Ditto. -- Zero.

¹Table includes data available through May 1, 2018. Data are rounded to no more than three significant digits.

²Includes natural and synthetic tantalum-containing ores and concentrates. Ta content of ores and concentrates is estimated assuming 32% Ta₂O₅ in synthetic and niobium ores and concentrates and 37% Ta₂O₅ in tantalum ores and concentrates. Ta content of Ta₂O₅ is 81.897%.

³Tantalum content estimated at 100%.

⁴Average annual price per Ta₂O₅ content as reported by CRU Group.

⁵Weighted average value of imported plus exported materials.

TABLE 2
U.S. FOREIGN TRADE IN TANTALUM-CONTAINING ORE AND CONCENTRATE AND TANTALUM METAL AND ALLOYS, BY CLASS¹

| HTS ² code | Class | 2015 | | 2016 | | Principal destinations and sources in 2016 (gross quantity in kilograms and values in thousand dollars) |
|---------------------------------|--------------------------------|-------------------------------|----------------------|-------------------------------|----------------------|--|
| | | Gross quantity (kilograms) | Value (thousands) | Gross quantity (kilograms) | Value (thousands) | |
| Exports: | | | | | | |
| 2615.90.3000 | Synthetic concentrates | 138,000 | \$3,260 | 379,000 | \$6,030 | China 153,000, \$839; Mexico 88,200, \$1,640; Hong Kong 71,900, \$1,860. |
| 2615.90.6030 | Niobium ores and concentrates | 73,400 | 557 | 14,300 | 103 | Germany 4,740, \$33; India 4,250, \$30; United Kingdom 2,110, \$15. |
| 2615.90.6060 | Tantalum ores and concentrates | 98,200 | 4,860 | 162,000 | 7,300 | Thailand 155,000, \$7,120; France 5,190, \$114; India 2,250, \$62. |
| 8103.20.0030 | Unwrought, powders | 230,000 | 84,600 | 192,000 | 73,800 | Mexico 111,000, \$45,000; El Salvador, 61,100, \$16,700; Israel 10,100, \$5,180. |
| 8103.20.0090 | Unwrought, other | 5,300 | 2,140 | 31,100 | 9,000 | El Salvador 13,300, \$3,110; Mexico 6,900, \$2,940; Germany 5,180, \$1,400. |
| 8103.30.0000 | Waste and scrap | 280,000 | 42,700 | 171,000 | 23,200 | Kazakhstan 33,300, \$6,030; Canada, 32,900, \$2,380; Japan 22,800, \$3,830. |
| 8103.90.0000 | Wrought | 57,300 | 36,200 | 58,000 | 34,300 | Germany 16,700, \$7,270; Republic of Korea, 16,200, \$10,800; China 13,000, \$8,540. |
| Total exports | | XX | 174,000 | XX | 154,000 | |
| Imports for consumption: | | | | | | |
| 2615.90.6030 | Niobium ores and concentrates | -- | -- | 1,160 | 18 | China 697, \$8; Canada 467, \$10. |
| 2615.90.6060 | Tantalum ores and concentrates | 730,000 | 49,300 | 675,000 | 37,300 | Brazil 440,000, \$26,000; Australia 97,900, \$3,900; Congo (Kinshasa) 83,300, \$4,410. |
| 8103.20.0030 | Unwrought, powders | 150,000 | 58,400 | 156,000 | 52,200 | Germany 65,900, \$22,500; China 41,000, \$14,400; Thailand 31,100, \$12,500. |
| 8103.20.0090 | Unwrought, other | 266,000 ^r | 91,200 ^r | 164,000 | 45,400 | China 85,900, \$23,100; Kazakhstan 64,100, \$19,100; Germany 5,170, \$1,590. |
| 8103.30.0000 | Waste and scrap | 565,000 ^r | 55,400 ^r | 489,000 | 41,900 | Mexico 97,100, \$4,190; Austria 82,700, \$2,680; Germany 73,000, \$10,600. |
| 8103.90.0000 | Wrought | 41,300 | 21,500 | 47,900 | 20,600 | China 28,800, \$11,200; Austria 4,320, \$2,800; United Kingdom 4,070, \$1,240. |
| Total imports | | XX | 276,000 | XX | 197,000 | |

^rRevised. XX Not applicable. -- Zero.

¹Table includes data available through May 1, 2018. Data are rounded to no more than three significant digits; may not add to totals shown.

²Harmonized Tariff Schedule of the United States.

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

TABLE 3
U.S IMPORTS FOR CONSUMPTION OF TANTALUM ORES AND CONCENTRATES,
BY COUNTRY OR LOCALITY^{1,2}

| Country or locality | 2015 | | 2016 | |
|---------------------|-------------------------------|----------------------|-------------------------------|----------------------|
| | Gross quantity (kilograms) | Value (thousands) | Gross quantity (kilograms) | Value (thousands) |
| Australia | 117,000 | \$6,380 | 97,900 | \$3,910 |
| Bolivia | 1,280 | 5 | -- | -- |
| Brazil | 177,000 | 20,200 | 440,000 | 26,000 |
| Canada | 2 | 4 | -- | -- |
| China | 806 | 109 | 1,670 | 319 |
| Congo (Brazzaville) | 19,900 | 929 | -- | -- |
| Congo (Kinshasa) | 90,500 | 4,340 | 83,300 | 4,410 |
| Germany | 80 | 18 | -- | -- |
| Korea, Republic of | -- | -- | 7 | 3,360 |
| Mexico | 329 | 8 | -- | -- |
| Mozambique | -- | -- | 4,120 | 481 |
| Rwanda | 302,000 | 16,600 | 47,700 | 2,170 |
| Tanzania | 20,600 | 737 | -- | -- |
| Total | 730,000 | 49,300 | 675,000 | 40,600 |

-- Zero.

¹Table includes data available through May 1, 2018. Data are rounded to no more than three significant digits; may not add to totals shown.

²Harmonized Tariff Schedule of the United States code 2615.90.6060.

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

TABLE 4
TANTALUM: WORLD PRODUCTION OF MINERAL CONCENTRATES, BY COUNTRY OR LOCALITY¹

(Kilograms, tantalum content)

| Country or locality ² | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|------------------------|---------------------|------------------------|------------------------|-----------|
| Bolivia, tantalite concentrate | 10,565 | 11,547 | 5,638 | 5,479 ^r | 5,479 |
| Brazil, mineral concentrate ³ | 96,600 | 152,000 | 96,600 | 98,300 ^r | 103,000 |
| Burundi, mineral concentrate ^e | 51,000 | 14,000 | 21,000 | 10,000 ^r | 16,000 |
| Canada, tantalite concentrate | -- | 32,800 ^r | -- | -- | -- |
| China, mineral concentrate | 45,000 ^e | 48,000 ^e | 61,000 ^e | 95,000 ^e | 94,000 |
| Congo (Kinshasa): ^e | | | | | |
| Cassiterite concentrate | 120,000 | 110,000 | 160,000 | 130,000 | 150,000 |
| Columbite-tantalite concentrate | 130,000 | 160,000 | 290,000 | 220,000 | 220,000 |
| Ethiopia, columbite-tantalite concentrate | 100,000 ^r | 11,000 ^r | 46,000 ^r | 59,000 ^r | 63,000 |
| Mozambique, columbite-tantalite concentrate | 83,000 | 43,000 | 23,000 | 13,000 ^r | 19,000 |
| Nigeria, mineral concentrate ⁴ | 75,000 | 110,000 | 150,000 | 150,000 | 192,000 |
| Rwanda: ^e | | | | | |
| Cassiterite concentrate | 70,000 | 70,000 | 90,000 | 60,000 | 50,000 |
| Columbite-tantalite concentrate | 240,000 | 530,000 | 490,000 | 350,000 | 300,000 |
| Uganda, mineral concentrate | -- | -- | -- | 5,300 ^{r,e} | 4,600 |
| Total | 1,020,000 ^r | 1,290,000 | 1,430,000 ^r | 1,200,000 ^r | 1,220,000 |

^eEstimated. ^rRevised. -- Zero.

¹Table includes data available through August 30, 2017. All data are reported unless otherwise noted. Totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

²In addition to the countries and (or) localities listed, Australia, French Guiana, and Russia may have produced tantalum mineral concentrates, but available information was inadequate to make reliable estimates of output quantity.

³Includes djalmaite and tantalite.

⁴Includes cassiterite and tantalite concentrates.