25 TANTALUM

25.1 Overview

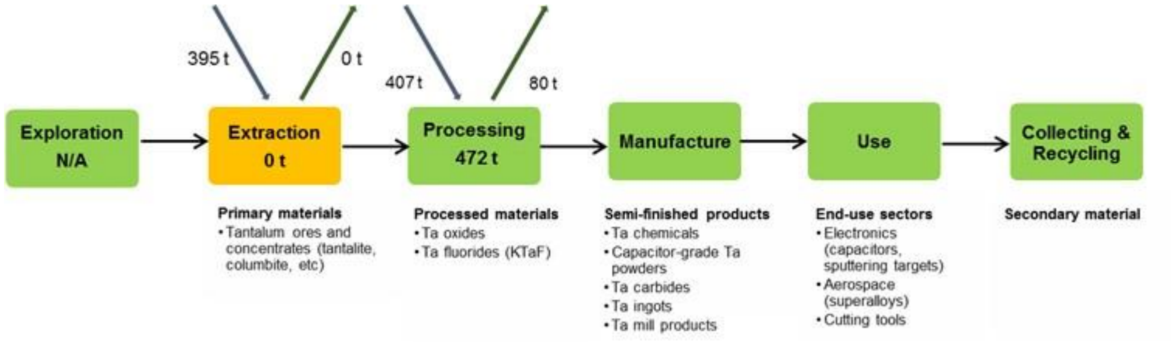

Figure 471: Simplified value chain for tantalum for the EU, averaged over 2012-2016[267]

Tantalum (chemical symbol Ta) is a silvery-grey hard, transition metal. It has a high density (16.6 g/cm^3) and the fourth highest melting point (3,020°C). It is highly resistant to corrosion and has a great permittivity. Tantalum's estimated abundance in the upper continental crust is 0.9 ppm (Rudnick, 2003), which is quite rare. It is not found as a free metal in nature but occurs notably in the minerals microlite and tantalite-columbite. Most tantalum is produced as a co-product as it occurs in complex mineral form, often associated in ore bodies with niobium, tin or lithium. Tantalum was on the list of CRMs in 2011 and 2017, but not in 2014.

For the purpose of this assessment, the criticality of tantalum was assessed at mine stage in ores and concentrates form. The trade code for tantalum is CN 261590, "Niobium, Tantalum & Vanadium Ores & Concentrates" (Eurostat Comext, 2019).

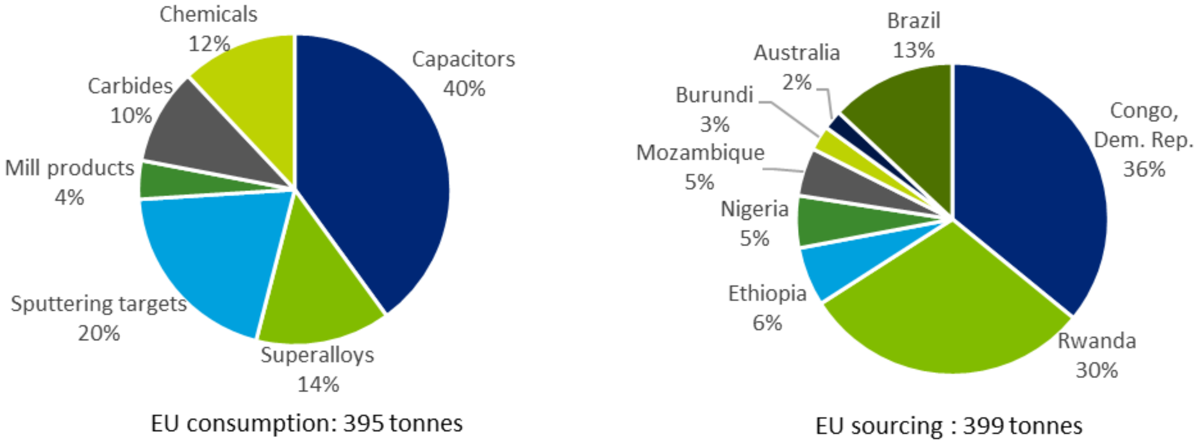

Figure 472: End uses (SCRREEN, 2019) and EU sourcing of tantalum ores and concentrates, average 2012-2016 (T.I.C, 2019).

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[267] JRC elaboration from multiple sources (see next sections). The orange box of the extraction stage suggest that extraction activity is not undertaken within the EU.

Tantalite (30% Ta_2O_5) prices on the international market decreased from 2014's price at USD 187 per kg of Ta_2O_5, reaching the lowest at around USD 124 per kg in 2016. Since then, the price of tantalum has increased, up to USD 203 per kg of Ta_2O_5 in 2018.

The EU is a net importer of tantalum ores and concentrates. The EU annual average consumption of tantalum over the period 2012-2016 was estimated to be around 395 tonnes per year (T.I.C, 2019). The EU sourced tantalum mainly from African suppliers.

The main uses of tantalum are in capacitors (electronic devices, cell phones etc.), superalloys (aerospace), sputtering targets (storage media, inkjet printer heads etc.), but also carbides (cutting tools), mill products, medicals and chemicals. The current tantalum consumption is limited to those applications in which tantalum cannot be substituted without a significant loss of performance and quality (European Commission, 2017).

Tantalum, together with tungsten are indispensable for the whole manufacturing and tooling industry, i.e. robotics and Artificial Intelligence. No manufacturing of solar panels, wind turbines, etc. would be possible without tooling industry (Euromines, 2019).

USGS indicates that identified resources of tantalum are located in Australia, Brazil, and Canada. Some deposits were also identified in the United States, but they were considered uneconomic at 2018 prices for tantalum. In Europe, potential resources of tantalum (and niobium) were reported to exist in Finland, France, Portugal, Norway, Sweden, Greenland and Germany with no further evaluation (Mineras4EU,2014). Reserves of tantalum were identified in Australia and in Brazil, although this information may be incomplete (USGS, 2019). No reserves of tantalum in the EU were identified.

The world annual production of tantalum over the period 2012-2016 was reported at 1,190,000 tonnes. More than half of this quantity was produced in Democratic Republic of Congo (33%) and Rwanda (28%) (WMD, 2019). The major part of supply in recent years comes from artisanal mining. There was no production of tantalum in the EU. Processor scrap and other secondary materials are another important part of tantalum supply. In the EU, various recyclers and processors count tantalum in their activities. They are located in Germany, Austria and the UK (Roskill, 2016).

No environmental restriction is known for tantalum. Regulatory issues are linked with Conflict minerals legislation issues (European Parliament, 2016). The production of tantalum is also closely related to the activities of artisanal and small-scale miners (ASM), often operating outside health, safety and environmental standards (RMIS, 2019).

25.2 Market analysis, trade and prices

25.2.1 Global market analysis and outlook

On the supply of tantalum, since the late 1990s, the tantalum market has shown much instability and volatility. Much uncertainty comes from the potential development of new deposits. The tantalum market was in a slight supply surplus in 2010-2014, and could remain so for the next few years from 2017, resulting in low prices that discourage new producers coming on stream (European Commission, 2017).

As for supply risks, the level of confidence concerning tantalum trade in Central Africa is a key parameter. Since 2009, many institutional and industry led initiatives have improved transparency on artisanal mining. Nevertheless the current political instability in the region could have a negative impact on future trade, bringing the notion of conflict tantalum back to prominence again. In the case of new conflicts rising, the risk of another de-facto embargo could weigh on the region and cause a dramatic increase in prices (European Commission, 2017).

On the demand side, SCREEEN carried out a study on major trends affecting future demand for tantalum. The study covered the uses of tantalum as capacitors in smartphones an computers and superlloys in jet engines. The study concluded that the use of tantalum in smartphones should drive the future of tantalum towards 2035 although a higher demand from the superalloys sector is predicted to come. The increase in tantalum requirements are expected to be driven by the growth of demand related to social needs (social network activities, on-line service, etc) and the demand for smaller and more integrated devices (Monnet, 2018).

Table 197: Qualitative forecast of supply and demand of tantalum

Materials	**Criticality of the material in 2020**		**Demand forecast**			**Supply forecast**		
	Yes	No	5 years	10 years	20 years	5 years	10 years	20 years
Tantalum	x		+	+	?	?	?	?

25.2.2EU trade

No public data was available to assess the EU imports and exports of tantalum ores and concentrates. Tantalum ores and concentrates in Eurostat-Comext is represented as a mix with niobium and vanadium in CN code 261590: "Niobium, tantalum, or vanadium ores and concentrates". Moreover, Eurostat-Comext returned empty tables for import and export of such commodity. Experts have provided estimation regarding EU imports and exports of tantalum ores and concentrates.

The EU is a net importer of tantalum ores and concentrates. The amount of EU imports at 60-100 tonnes per year of tantalum concentrates as reported in the criticality assessment 2017 (averaged over 2010 to 2014), was considered as too low by experts. T.I.C. (2019) estimates that EU imports of tantalum pentoxides (Ta_2O_5) exceed 500 tonnes per year, stable from 2012-2016 period. The EU imported about 395 tonnes of tantalum content per year over the period 2012-2016 (T.I.C., 2019). France and Germany are the main importers of tantalum concentrates (T.I.C., 2019).

The main suppliers for the EU are African countries, i.e. Democratic Republic of Congo (36%), Rwanda (30%), Ethiopia (6%) and Nigeria (5%). The African countries breakdown is an estimate based on the share of each country in global supply.

Burundi, that supplied 3% of EU import imposed 30% of export tax for HS 26159090 "Other", in which tantalum concentrates and ore are a part of it. Rwanda applied "fiscal tax on exports" of 4% on HS 261590 "Niobium, Tantalum & Vanadium Ores & Concentrates" which includes the following HS codes of products: 2615909010 "Niobium, tantalum concentrates and ores" and HS 2615909090 "Vanadium ores and concentrates". Currently there are no EU free trade agreements in place with Rwanda.

The EU production of tantalum in the EU between 2012 and 2016 took place in France, at the rate of 4.9 tonnes per year, that was entirely exported outside the EU (Bourgeois, F. et. al, 2017).

HC Starck in Germany is likely to be one of the main re-exporter of Ta concentrates, linked with intra-company material transfers to Thailand, USA and Japan (Roskill, 2016). In 2018, Tantalum & Niobium Division of HC Starck was reported to have been sold to Japan's JX Group (Roskill, 2018).

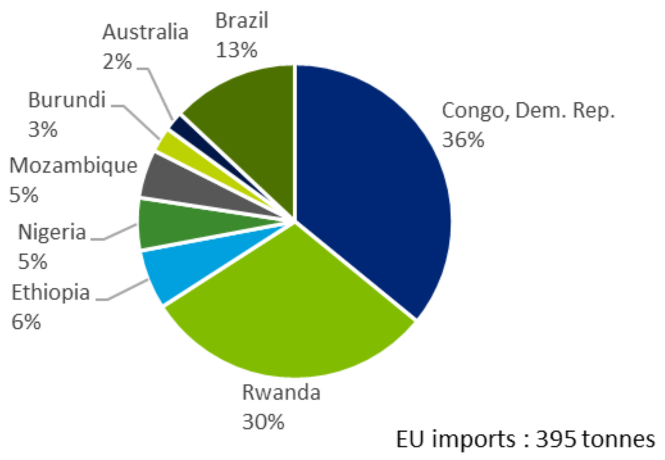

Figure 473: EU imports of tantalum ores and concentrates, averaged over 2012-2016 (T.I.C., 2019)

25.2.3Prices and price volatility

Tantalum is not traded on any metals exchange, and there are no terminal or futures markets where buyers and sellers can fix an official price. References for prices are obtained through averages of past deals between private parties, generally available through paid subscription (e.g. Asian Metal, Metal Pages).

Figure 474 shows the prices of tantalum concentrates (30% Ta_2O_5) and tantalum pentoxide (min. 99.5% Ta_2O_5, fob China). It is also of interest to note that as we move toward the value chain, added-values escalate rapidly for selected tantalum products. The price of tantalum pentoxide (99.5% min. Ta_2O_5) is higher than tantalum concentrates.

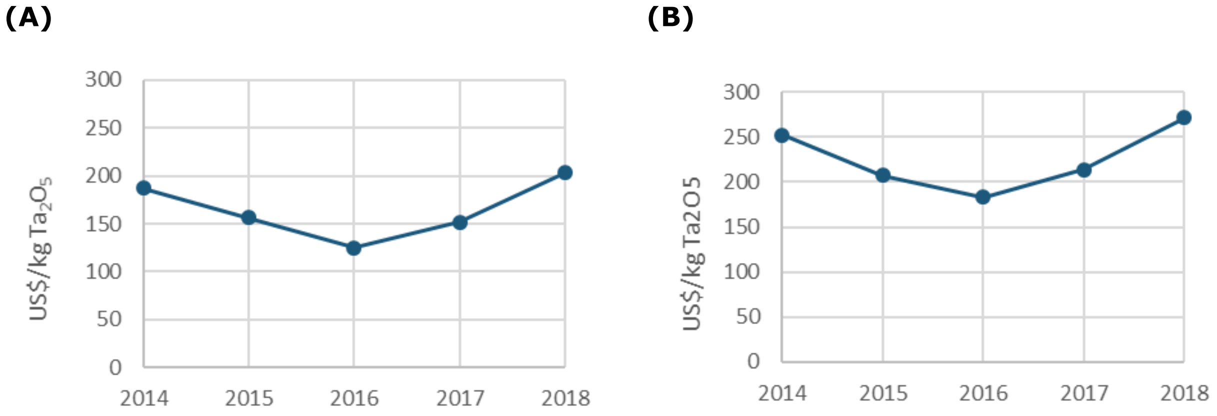

Figure 474: Tantalite concentrate (30% Ta_2O_5) (A), and pentoxide (min. 99,5% Ta_2O_5, fob China) (B) in USD/kg of Ta_2O_5 Data source: DERA (DERA, 2019)

25.3 EU demand

25.3.1 EU consumption

Apparent consumption figures for tantalum derived from adding EU production and imports and subtracting exports are not reliable because of uncertainties related to the amount of tantalum produced, traded, or integrated in finished goods at every level.

The EU consumption of tantalum concentrates and tantalum pentoxide was estimated to exceed 500 tonnes per year, stable over the year 2012-2016 (T.I.C., 2019). The EU imports was estimated at 395 tonnes annually, equivalent to 25% of the tantalum available in the market in 2012-2016 (T.I.C., 2019). France and Germany were known as the main importer of tantalum in the EU (T.I.C., 2019).

25.3.2 Uses and end-uses of tantalum in the EU

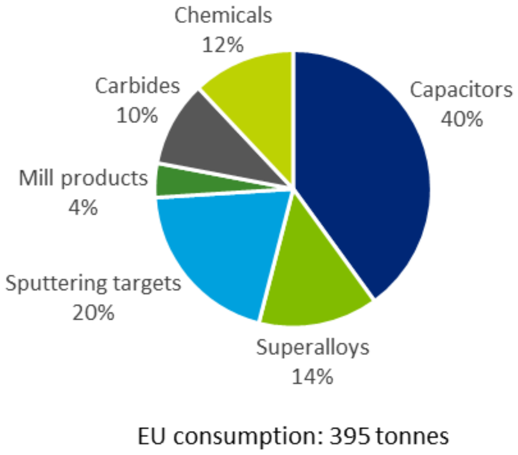

Figure 475: EU end uses of tantalum. Average figures for 2012-2016. (SCRREEN, 2019)

Figure 475 presents the main uses of tantalum in the EU. The manufacture of capacitors is the largest single use of tantalum worldwide. All electronic devices contain capacitors, they are used to store an electrical charge for later use, and consist of two conducting surfaces (metal plates) separated by a dielectric insulating material. In the case of tantalum capacitors, the dielectric is a thin film of tantalum pentoxide that forms naturally on the surface of tantalum metal to protect it from corrosion. The vast majority of capacitors in electronic devices do not contain tantalum; the use of tantalum is favoured when high capacitance, small size and high performance are required. Such capacitors are now limited to applications where they are irreplaceable. In the EU, the majority of tantalum use in capacitors comes from imported finished products rather than manufacturing. In 2016, only one capacitor manufacturer seems to be active, AVX in Czech Republic (European Commission, 2017).

Superalloys are an important use of tantalum in the EU, due to the prominence of the aerospace sector. Roskill estimates that the EU could consume half of tantalum used globally in superalloys (Roskill, 2016). As aircraft design and performance expectations improve, the alloys involved become more sophisticated and the loading of tantalum in alloys is increasing (together with other specialty metals). Superalloys find applications in the manufacture of jet engines for example, but also for land-based gas turbines.

Sputtering targets are another major application for tantalum although less important in the EU (only in imported finished products). Sputtering is a method of applying thin films of metal to a substrate and is used in the manufacture of storage media, inkjet printer heads, electronic circuitry and flat-panel displays, among others. The target is the source of the metal that is deposited. Tantalum chemicals have a very wide range of applications and are intermediates in the manufacture of other products that are often destined for the electronics industry. Tantalum mill products have a very wide range of uses, including chemical processing equipment, ballistics and surgical implants. Tantalum carbides are used in cutting tools.

Tantalum is also used in medical applications (medical device implants, bone and joint replacements), but with a very low share (<1%).

Relevant industry sectors are described using the NACE sector codes (Eurostat, 2019c).

Table 198: Tantalum applications, 2-digit and associated 4-digit NACE sectors, and value added per sector (Eurostat, 2019c)

Applications	**2-digit NACE sector**	**4-digit CPA sectors**	**Value added of NACE 2 sector (millions €)**
Capacitors	C26 - Manufacture of computer, electronic and optical products	C2610- Manufacture of electronic components	65,703
Aerospace	C30 – Manufacture of other transport equipment	C3030- Manufacture of air and spacecraft and related machinery	44,304
Sputtering targets	C26 - Manufacture of computer, electronic and optical products	C2610- Manufacture of electronic components	65,703
Mill products	C25 - Manufacture of fabricated metal products, except machinery and equipment	C2593- Manufacture of tools	148,351
Carbides	C28 – Manufacture of machinery and equipment n.e.c	(C2824-Manufacture of machinery for mining, quarrying and construction)	182,589
Chemicals	C20 – Manufacture of chemicals and chemical products	C2029-Manufacture of other chemical products n.e.c.	105,514

25.3.3Substitution

Substitutes of tantalum for different applications remain the same as in the years 2010-2014. No major change has been identified.

In capacitors, the vast majority of them in electronic devices do not contain tantalum, mostly because of their high prices. In terms of substitution, niobium (also considered a critical raw material for the EU since 2011) can be used to produce capacitors at lower cost, but they are usually larger and have a shorter life-span. Other alternatives are ceramic capacitors (multilayer or monolithic) or standard aluminium capacitors (both also have larger size, reduced capacitance and are more sensitive to harsh and hot operating conditions). The superior performance and robustness of tantalum capacitors thus remains the only reliable choice in applications where long term reliability, size and/or security matters (e.g. automobile anti-lock brake systems, airbag activation systems, satellites, etc.).

Tantalum carbides are used in cutting tools. Other refractory metals which share similar properties of strength and resistance at high temperatures can be substitutes for carbides (tungsten, niobium, titanium, molybdenum), although prices are often comparable.

In many types of superalloys tantalum is one of several elements added to the base metal (nickel, cobalt or iron) in small but precise quantities. Substituting tantalum for another element would dramatically alter the properties of the superalloy. Once a particular superalloy has been engineered into an aero engine or industrial gas turbine and approved for commercial use any subsequent change to that superalloy would take many years to become established. Tantalum plays a critical role in superalloys and in this application it is a relatively minor cost, making substitution unlikely.

25.4 Supply

25.4.1 EU supply chain

Over the period 2012-2016, there was no production of tantalum in the EU reported in the World Mining Data (WMD, 2019). However, production of tantalum is known to take place by Imerys, in France, producing 5 tonnes of Ta_2O_5 per year. The production of tantalum in France is all exported (Bourgeois, et. al., 2017). The EU therefore remained highly dependent on its foreign imports, with an import reliance of 100%.

At the processing and manufacturing stage, a small number of processors/manufacturers are present in the EU.

- At the processing stage, capacities are found in Germany and in Estonia (with the company NPM Silmet AS which processes columbite ore coming from Nigeria, to produce REEs, Nb and Ta products).
- Two capacitors manufacturing companies operate in Czech Republic (AVX) and in Portugal (Kemet).
- In the aerospace sector, which is one of the most important, a dozen of superalloys producers are known respectively in, France, Germany, Austria, Italy and Sweden, as well as companies using tantalum-containing superalloys to manufacture turbine blades for jet engines. Roskill estimates that the EU could consume half of tantalum used globally in superalloys (Roskill, 2016).
- Others uses include sputtering targets, another major application for tantalum although less important in the EU. The company H.C. Starck in Germany is a major player in this market, although most of its plants are outside the EU. Other markets such as tantalum carbides, tantalum chemicals and mill products also have EU users, although it is in modest quantities and quite diverse applications.
- EU supply is fed by processed and secondary materials to a large extent. As in the case of most minor metals, the EU hosts many companies active in the trading in Ta minerals and products.

25.4.2Supply from primary materials

25.4.2.1 Geology, resources and reserves of tantalum

Geological occurrence: Tantalum does not occur in a free state in nature, but in the form of complex oxides and other minerals. Whilst at least nineteen tantalum minerals had been recorded as early as 1982 (Foord, 1982), many of them are only of mineralogical interest. The main ones found in economic quantities are tantalite-columbite, microlite, wodginite and struverite. Tantalum minerals are often associated with cassiterite (the primary source of tin), and such ores are another important source of tantalum.

Tantalite-columbite is an isomorphous series, where tantalum and niobium may substitute with each other. Tantalite is the tantalum-rich end. The common ratios between the two are from 3:1 to 1:3, thus being either tantalo-columbite or columbo-tantalite (which is the most common, also shortened to 'coltan' especially in Central Africa). Microlite is the tantalum-rich end member of the microlite-pyrochlore series. Wodginite is less common, but was the primary tantalum mineral found in the original Wodgina deposit in Australia (from which it gained its name) and also at the Tanco mine in Canada. Struverite, a variation of rutile, is a low grade source of tantalum predominately associated with cassiterite in south-east Asia (Burt, 2016).

All primary tantalum (and niobium) deposits are associated with igneous rocks, and can be grouped into three types, on the basis of the associated igneous rocks:

- Peraluminous pegmatites and granites
- Alkaline to peralkaline granites and syenites
- Carbonatite-hosted deposits

Pegmatites have been, and continue to be, the most important source of tantalum mineralization, although only a very small fraction of pegmatites do contain tantalum. The two main periods where tantaliferous pegmatites were intruded are in the Archaean (>2.5 billion years ago) and the Proterozoic (500-1,400 million years ago) (Burt, 2016). Pegmatites are enriched in aluminium compared to the alkali based minerals (sodium and potassium-rich minerals) (Černý, 1989). Pegmatites are generally relatively small (1-100 million tonnes). They can be 'simple' or 'complex', with several discrete zones within the pegmatite, each zone containing significantly different mineral assemblages. In Central Africa many small pegmatites are found, which have been heavily weathered to the point of kaolinization and have become soft-rock deposits, particularly appropriate for artisanal exploitation.

Alkaline granites are enriched in the alkali based minerals compared to aluminium. They generally occur in rift or failed rift tectonic settings and are often relatively large deposits (100-1,000 million tonnes), with fine mineralogy (Burt, 2016). These rocks typically contain high contents of zirconium and rare earth elements (REEs) minerals. Significant concentrations of niobium and tantalum also occur, with the primary mineral being pyrochlore. A major example is the Pitinga mine in Brazil which is a Paleoproterozoic albite-rich peralkaline granite, exploited for tin, niobium and tantalum.

Syenites are another form of alkali feldspathic rock, with dominant nepheline syenite, generally highly complex. The Lovozero deposit in northern Russia is a prime example of an operating mine where tantalum and niobium are important by-products.

Carbonatites are igneous rocks that contain more than 50% carbonate minerals (calcite, dolomite or ankerite). Most carbonatites occur in rift settings, although several different types exist, many of which are unmineralised. Some can contain anomalous niobium-tantalum concentrations, along with various rare earth minerals. They are the main sources of niobium extraction.

Global resources and reserves[268]*:* USGS (2019) only indicates that identified resources of tantalum, most of which are in Australia, Brazil, and Canada, are considered adequate to meet projected needs. Some deposits were also identified in the United States, but they were considered uneconomic at 2018 prices for tantalum.

On the global level, data for tantalum reserves from USGS is the only reference available, presented in Table 199. Many major current producing countries are not represented in this reporting, in particular those from Central Africa because of the type of deposits and the fact that artisanal mining operations do not rely on any preliminary resources & reserves assessment.

Table 199: Global reserves of tantalum (USGS, 2019)

Country	**Reserves (tonnes of Ta)**
Australia	76,000 among which 37,000 JORC compliant
Brazil	34,000
Others	N.A
TOTAL	>110,000

EU resources and reserves*[269]:*

Potential resources of tantalum (and niobium) were reported to exist in Finland, France, Portugal, Norway, Sweden, Greenland and Germany with no further evaluation (Mineras4EU,2014). Historic resources estimates are given in Table 200, with only indicative values, as these numbers do not comply with international standards of reporting and are very likely to be overestimated, as well as being uneconomic in current market conditions.

In Portugal, there are knowledge gaps over the hundreds of Portuguese LCT and NYF pegmatites, explored and exploited for ceramic raw materials (quartz and feldspar). There is no formal legal

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[268] There is no single source of comprehensive evaluations for resources and reserves that apply the same criteria to deposits of tantalum in different geographic areas of the EU or globally. The USGS collects information about the quantity and quality of mineral resources but does not directly measure reserves, and companies or governments do not directly report reserves to the USGS. Individual companies may publish regular mineral resource and reserve reports, but reporting is done using a variety of systems of reporting depending on the location of their operation, their corporate identity and stock market requirements. Translations between national reporting codes are possible by application of the CRIRSCO template.[268], which is also consistent with the United Nations Framework Classification (UNFC) system. However, reserve and resource data are changing continuously as exploration and mining proceed and are thus influenced by market conditions and should be followed continuously.

[269] For Europe, there is no complete and harmonised dataset that presents total EU resource and reserve estimates for tantalum. The Minerals4EU project is the only EU-level repository of some mineral resource and reserve data for tantalum, but this information does not provide a complete picture for Europe. It includes estimates based on a variety of reporting codes used by different countries, and different types of non-comparable datasets (e.g. historic estimates, inferred reserves figures only, etc.). In addition, translations of Minerals4EU data by application of the CRIRSCO template is not always possible, meaning that not all resource and reserve data for tantalum the national/regional level is consistent with the United Nations Framework Classification (UNFC) system (Minerals4EU 2019).Many documented resources in Europe are based on historic estimates and are of little current economic interest. Data for these may not always be presentable in accordance with the UNFC system. However a very solid estimation can be done by experts.

obligation to follow standard reporting codes (CRIRSCO compliant), making it difficult to gather reliable data on mineral resources and reserves in Portugal (Pereira, 2019).

Potential deposits of tantalum were also identified in south-west Finland, on Kemiö Island[270] discovered by the Geological Survey of Finland (GTK). The Exploration Licence for the project expired in October 2015 and the Company has applied for a renewal of the Licence.

In Spain, Penouta mine has recently been re-opened. The Penouta Mine was one of the most important tin mines in Spain that closed in 1985 without any restoration process. These residues present in this mine contained concentrations of metals, among others tantalum and niobium. Exploration is also ongoing at Alberta II deposit, containing pegmatites ore. The reserves is estimated as 12.3 tonnes with 0.0121% of tantalum pentoxide (Ta_2O_5) grade content (Bourgeois, et. al., 2017).

Reserves of tantalum are known to exist also in France, however, the estimated quantity information is confidential (Schwela, 2019).

Mineras4EU (2014) reports no data for tantalum reserves in Europe. In 2019, there has not been any update on Minerals4EU.

Table 200: Resource data for the EU compiled in the European Minerals Yearbook of Minerals4EU (2019)

Country	Reporting code	Value	Weighted Average Grade	Code Resource Type
Finland	None	251 Mt	0.0062% Ta_2O_5	Historic Resource Estimates
France	None	7,900 t	Ta-Nb content	Historic Resource Estimates
Portugal	None	8.04 Mt	41.79 g/t of ?	Historic Resource Estimates
Norway	None	8.03 Mt	0.995	Historic Resource Estimates
Sweden	Historic	0.6 Mt	80 g/t of ?	Historic Resource Estimates

25.4.2.2 World and EU mine production

The annual world production of tantalum over the period 2012-2016 was estimated at 1,191 tonnes according to the data reported by World Mining Data (2019), shown in Figure 476. Figure 476 also shows a share of EU production that was not reported in World Mining Data.

According to national statistics, the two main producers in the years over 2012-2016 were the Democratic Republic of Congo (33%) and Rwanda (28%) both accounting for more than half of global primary supply. Nevertheless data reported from those two countries are always subject to uncertainties, due to the difficulties of tracing artisanal mining total output despite numerous initiatives to increase transparency (OECD, iTSCi etc.). Brazil accounted for 9% of global production, followed by an important number of smaller players.

.T.I.C. (2019) estimated the world annual production of tantalum 2012-2016 amounted to 1,580 tonnes of tantalum

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[270] https://www.tertiaryminerals.com/index.php?route=projects/other-projects/rosendal#heading-0

In 2012-2016, China and Burundi imposed export tax for HS 26159090 "Other", the following products are under this HS code: 2615909010 "Niobium, tantalum concentrates and ores" and HS 2615909090 "Vanadium ores and concentrates". Rwanda applied "fiscal tax on exports" of 4% on HS 261590 "Niobium, Tantalum & Vanadium Ores & Concentrates" for which the tantalum concentrates and ores was included.

Some production of tantalum was reported in France, at 4.9 tonnes of tantalum per year, accounting for 0.3% of global supply over the years 2012-2016.

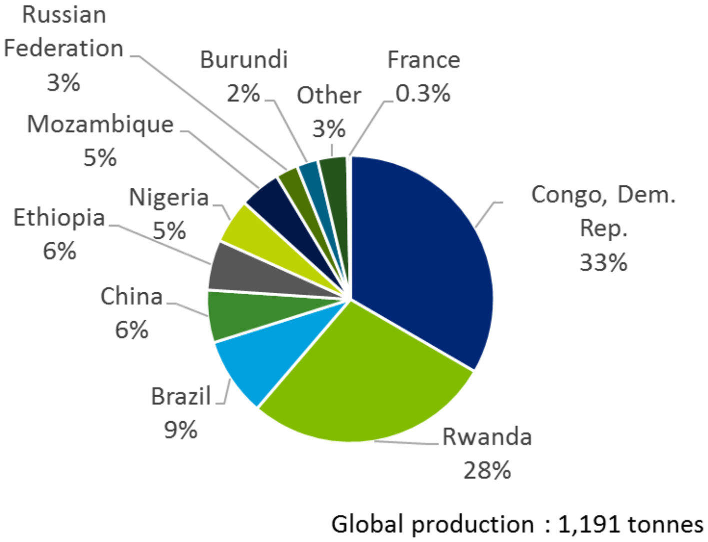

Figure 476: Global production of tantalum in tonnes and percentage. Average for the years 2012-2016 (World Mining Data, 2019).

The Penouta mine is a historic mine containing tantalum, tin and niobium in Spain. In 2018, Strategic Minerals Spain (SMS) started the processing of tailings from waste-rock heaps and ponds of the old Penouta mine leading to the obtaining of tantalum and niobium minerals through a gravimetric separation process, without any chemical products or waste that is harmful to the environment. It is estimated that the mineral resources in the remaining original deposit amount to 95.5 Mt of Measured and Indicated Mineral Resources with average grades of 77 ppm Ta and 443 ppm Sn, and in the old tailing waste-rock heaps where the company has started operations 12 Mt of resources with average grades of 35 ppm Ta and 428 ppm Sn[271].

25.4.3Supply from seconday materials

The recycling rates for tantalum vary depending on the type of material and stage in the supply chain. At the processor level, it is in company’s interest to achieve as high yield as possible (Schwela, 2019).

Tantalum can be recovered from scrap, incineration bottom ash, superalloys, pyrometallurgical slag, and tin slag. Tantalum is commonly extracted from scrap, slags, or scraps through high

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[271] Blengini, G.A.; Mathieux, F., Mancini, L.; Nyberg, M.; Viegas, H.M. (Editors); Salminen, J.; Garbarino, E.; Orveillon, G.; Saveyn, H.; Mateos Aquilino, V.; Llorens González, T.; García Polonio, F.; Horckmans, L.; D'Hugues, P.; Balomenos, E.; Dino, G.; de la Feld, M.; Mádai, F.; Földessy, J.; Mucsi, G.; Gombkötő, I.; Calleja,I. Recovery of critical and other raw materials from mining waste and landfills: State of play on existing practices, EUR 29744 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-76-08568-3, doi:10.2760/600775, JRC116131.

temperature digestion in a sulfuric acid, resulting in a highly purified tantalum and niobium (Sundqvist Oeqvist, Pr. Lena et al. ,2018).

The end-of-life recycling input rate of tantalum products is under 1% (UNEP, 2011). Nevertheless, recycling of used items containing tantalum exists, but it is primarily 'pre-consumer', that is from within the upstream supply chain itself, rather than from end-users. In the aeronautic industry for instance, turbine blades are reprocessed. The composition of superalloys is known or can be tested, and the alloys are added to the melt when producing new alloys (Roskill, 2016).

Processor scrap and other secondary materials are also an important part of tantalum supply. Scrap generated during manufacturing, for example of capacitors, is returned to processors. The main source of this recycled material is from the electronics industry (capacitors, sputtering targets, etc.). Estimates from various sources give that about 30% of new demand for tantalum in any year is met from such material, a figure that hardly varied for a few decades (Burt, 2016).

In the EU, various recyclers and processors count tantalum in their activities. Some key actors in tantalum recovery are available in Germany, Estonia, France (from kaolin mining), and Spain (from tin mining). (Sundqvist Oeqvist, Pr. Lena et al. ,2018).

25.4.4Processing of tantalum

No data was available for global and European production of processed materials (Ta oxides and fluorides). WMD, BGS and USGS reported tantalum production only at the extraction stage. There is no Eurostat trade code for tantalum oxides and fluorides in ProdCom and in Eurostat-Comext.

The world production of intermediate products is not known. T.I.C (2019) reported an estimate of 2,200 tonnes of Ta_2O_5, K_2TaF_7, as well as secondary products are generated each year, equivalent to 1,200 tonnes of tantalum. The top three producers of tantalum processed materials are China, Germany, and the United States. No exact production shares are available (Schwela, 2019).

Even though producing countries are quite diverse at the extraction stage, the next steps of tantalum value chain are more concentrated in Asia.

The International Trade Administration (ITA) reported a list of identified companies known to be the consumers of tantalum ores and concentrates (Figure 477). This list contains global facilities known to be able to process tantalum concentrate to produce industrial tantalum products. According to this list, China was reported to have the highest number of tantalum facilities.

China is the main importer of tantalum concentrates globally, and operates more than half of the "official" 3Ts (tin, tantalum, tungsten) smelters processing tantalum (Figure 477), a number that could have increased. China is also a major exporter of processed Ta-products, to the EU, US and others.

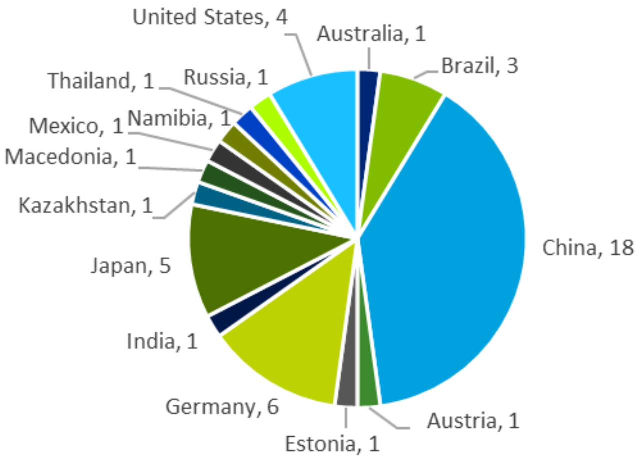

Figure 477: Identified global consumers of tantalum concentrates in 2018 in number (ITA, 2018)

25.5 Other considerations

25.5.1 Environmental and health and safety issues

No environmental restriction is known for tantalum.

25.5.2 Socio-economic issues

The Regulation of the European Parliament and of the Council sets up a Union system for supply chain due diligence self-certification in order to curtail opportunities for armed groups and unlawful security forces to trade in tin, tantalum and tungsten, their ores, and gold. It will take effect on 1 January 2021. It is designed to provide transparency and certainty as regards the supply practices of importers, (notably smelters and refiners) sourcing from conflict-affected and high-risk areas. The EU regulation covers tin, tantalum, tungsten and gold, because these are some of the minerals that are most often linked to armed-conflicts and related human rights abuses[272].

The Regulation requires importers to follow a five-step framework which the Organisation for Economic Co-operation and Development (OECD) has laid out in a document called 'Due Diligence Guidance for Responsible Supply Chains from Conflict-Affected and High-Risk Areas' (OECD Guidance).

The regulation only applies directly to EU-based importers of tin, tantalum, tungsten and gold, whether these are in the form of mineral ores, concentrates or processed metals.

In addition to the conflict minerals issue, approximately 20 to 25% of mined tin and tantalum are produced by artisanal and small-scale mining (ASM). ASM often operates outside health, safety and environmental legislation, therefore is characterised by vulnerability (limited capacity to cope with shocks and hazard) and marginalisation (as it is usually practised in remote areas, with limited access to markets) (RMIS, 2019).

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[272] https://ec.europa.eu/trade/policy/in-focus/conflict-minerals-regulation/index_en.htm

25.6 Comparison with previous EU assessments

The assessment has been conducted using the same methodology as for the 2017 list. The supply risk of tantalum was assessed based on global supply concentration at mine stage. The results of this and earlier assessments are shown in Table 201.

Table 201: Economic importance and supply risk results for tantalum in the assessments of 2011, 2014, 2017, 2020 (European Commission, 2011; European Commission, 2014; European Commission, 2017)

Assessment	2011		2014		2017		2020	
Indicator	EI	SR	EI	SR	EI	SR	EI	SR
Tantalum	7.4	1.1	7.4	0.6	3.9	1.0	3.9	1.36

The end-use application of tantalum in the EU has not changed since the criticality assessment 2017. Although there has been a change in value added in the sectors for which tantalum was relevant, the economic importance of tantalum remained the same as the results from criticality assessment 2017.

The supply risk of tantalum showed a higher value in comparison to the result from criticality assessment 2017. The only known EU domestic production of tantalum between 2012-2016 from France was exported. The EU relied exclusively on import to meet its demand.

The figure from World Mining Data showed a global increasing trend in the production of tantalum, especially with the contribution of countries with high WGI value like Democratic Republic of Congo (33% of global production share). The global production of tantalum became more concentrated in countries with high WGI values and this was reflected in higher supply risk value.

25.7 Data sources

Information on country by country production is only available for tantalum ores and concentrates at the global level. However, such information is still relatively opaque due to the fact that a great part is coming from artisanal mining, and that the global market is small (2,000 tonnes) (European Commision, 2017). In Eurostat Comext, the trade data on tantalum ores and concentrates refers to the trade code 261590: Niobium, tantalum, or vanadium ores and concentrates. However, Comext returned empty tables for import and export.

The data on the EU import of tantalum was provided by Tantalum-Niobium International Study Center (T.I.C.). T.I.C. uses another approach to build supply statistics; primary production estimates rely on declaration of shipments to processors, which allows summing all materials at the global level but do not give any indication of the origin of products. Traceability of individual producers is lost at this level. Furthermore, the same applies for processed materials which are grouped by categories (capacitor-grade Ta powders, Ta chemicals, Ta carbides, etc.) and summed at the global level in a similar way. It is even more difficult to trace origins for these intermediary products, as customs codes are even more diverse and sometimes wrongly classified (European Commission, 2017).

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