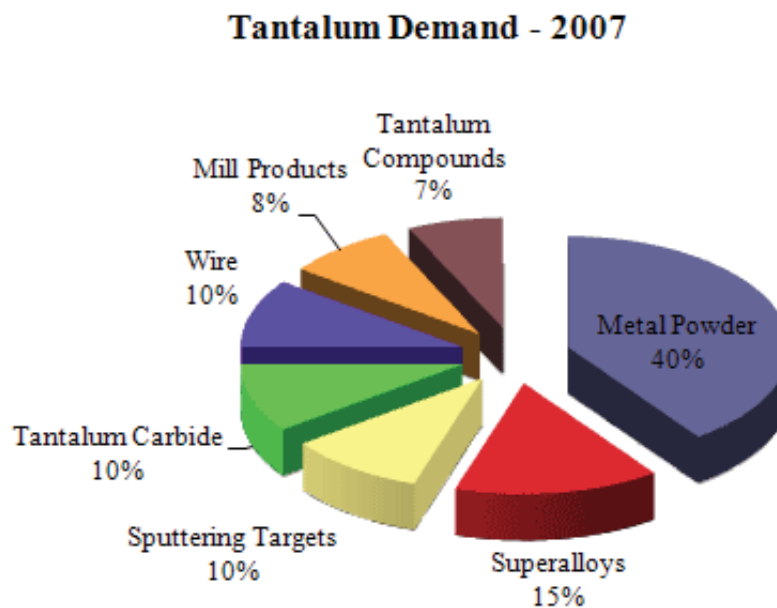


it has an extremely high melting point, 5,463°F, one exceeded only by rhenium (5,767°F) and tungsten (6,192°F). In addition, at low temperatures, not only is it nontoxic, but it is also practically totally resistant to chemical corrosion - acid and alkali.

A Modern Metal

Quite apart from having been discovered relatively recently, tantalum's uses are decidedly modern, especially its main use in electronics: in capacitors.



Source: [Talisn Minerals](#)

While tantalum capacitors may command only a 3-5% share of the overall capacitor market, in 2007, according to figures from Talison Minerals (until recently the world's largest single producer of tantalum), demand for the tantalum wire and metal powder used to make them accounted for around 50% of global tantalum production (around 2,000 tonnes of tantalum metal).

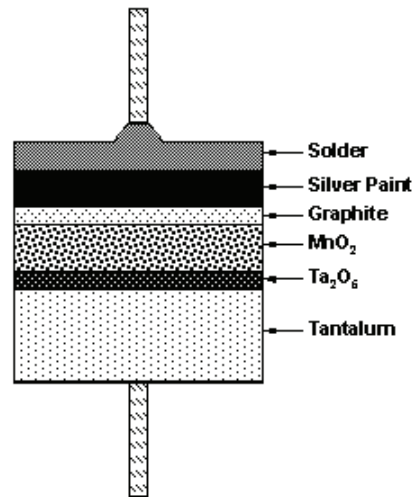
And, according to the U.S. Geological Survey (USGS), in the U.S. in 2007, the figure was even higher: tantalum capacitors "were estimated to account for more than 60% of tantalum use." In percentage terms, it is probably safe to assume that its use in capacitors in 2008 was roughly similar.

Tantalum capacitors themselves are used in anything from mobile phones to laptops, video & digital cameras and PlayStations, and from automotive subsystems (airbags, ignition controls and ABS brakes), to pacemakers and hearing aids.

What Are Capacitors?

In electronics, capacitors store charge.

A Conceptualized Tantalum Capacitor



MnO₂ = manganese dioxide

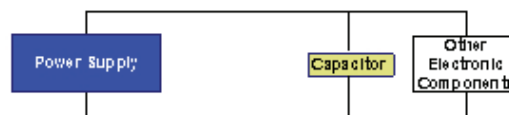
Ta₂O₅ = tantalum pentoxide

NB: While the conceptualized tantalum capacitor above employs a manganese dioxide “counter electrode,” today, many state-of-the-art tantalum capacitors employ conductive polymer counter electrodes.

When required to do so, within digital circuitry, capacitors can deliver that charge much faster than can the power supply to that circuitry.

Capacitors can be thought of as being akin to the water tanks atop buildings (into which the public water system feeds) that act as buffers between our faucets and the water mains.

A Capacitor in a Circuit...



... is Analogous to a Storage Tank in Water System



Source: [Cabot Corporation](#)

The other major uses of tantalum include:

- *Superalloys*: Because it is both very hard and has such a high melting point, tantalum is used extensively in the manufacture of turbine blades, both for jet engines and land-based gas turbines.
- *Tantalum Carbide*: As is tungsten carbide, so too is tantalum carbide used to make hard metals for drill bits and cutting blades. The largest consumer of these is the automotive industry.
- *Sputtering Targets*: Tantalum sputtering targets are used to deposit thin coatings of the metal (or tantalum nitride or tantalum oxide) on such things as semiconductors or glass.
- *Mill Products*: Supplied in the form of plates, rods, sheets and tubes, tantalum is then used across a broad range of different applications. These include use in: furnace parts, artificial hip joints and suture clips (the human body does not react to tantalum), corrosion-resistant nuts and bolts and various military applications; for example, gun barrel coatings and as a “liner” in EFP (explosively formed penetrator) anti-tank projectiles where the density of the long-rod penetrator (formed from the liner) is of great importance.
- *Tantalum Compounds*: Tantalum chemical compounds are used in such things as camera lenses, ink jet printers and X-ray film.

Tantalum Supply

The current primary source of tantalum is tantalum ores. Demand is, additionally, met from recycled tantalum scrap (the USGS estimated that, in 2007, tantalum contained in “imported tantalum scrap” accounted for some 30% of the apparent consumption of the metal in the U.S.: Tantalum has not been mined in the country since 1959) - the tantalum extracted from the tailings from old tin mining activities, and from inventory releases.

Toward the end of last year, Talison Minerals estimated that demand for tantalum in 2008 would be around 6.6 million lbs of contained Ta₂O₅ (tantalum pentoxide). (Quantities of tantalum mineral concentrate are always measured in terms of contained Ta₂O₅; prices are measured similarly.)

Tantalum Supply - 2008 (Estimated)

	%
Primary	71
Scrap	20
Tin Slag	7
Inventories	2

Source: [Talison Minerals](#)

It is important to realize, however, that the U.S. Defense Logistics Agency has now finally exhausted its stockpile of tantalum (in all forms), with its last sale therefrom in early 2007. Supply from primary sources has, consequently, grown from just over 50% of total supply in 2006, to an estimated 71% thereof in 2008.

Primary production of tantalum was estimated by Talison to reach some 4.3 million pounds of contained Ta₂O₅ in 2008.

Geographical Production

Country/Region	%	Ta ₂ O ₅ lbs
Africa	37	1,591,000
Australia	30	1,290,000
Brazil	14	602,000
China	8	344,000
Asia Other	4	172,000
Canada	4	172,000
Russia	3	129,000
	100	4,300,000

Source: [Talison Minerals](#)

The world's tantalum mining industry is quite concentrated geographically, with not all the important operations being in the most stable geopolitical locations.

Major Primary Tantalum Producers



Source: [Talison Minerals](#)

All 30% of the world's tantalum mineral concentrates mined in Australia in 2008 came from Talison Mineral's Wodgina tantalum operations. And by far the largest proportion of those concentrates mined in Africa from a single operation came from Noventa's Marropino mine in Mozambique - in 2008, the world's second-largest tantalum mining operation.

Some Major Tantalum Mining Operations in 2008

<i>Country</i>	<i>Mining Operation</i>	<i>Production - Ta₂O₅, lbs p.a. *</i>	<i>Owner</i>
Australia	Wodgina	1,300,000	Talison Minerals
Mozambique	Marropino	200-300,000 [‡]	Noventa
Ethiopia	Kenticha	100-170,000	State Owned (EMDSC)
Brazil	Pitinga (& Rocha Sã)	150-200,000	Paranapanema
Brazil	Mibra	100,000	Metallurg
China	Yichun	>120,000	China Minmetals
China	Nanjing	116,000	China Minmetals and Shenzhen Jiuweihang
Canada	Tanco	150,000	Cabot Corporation

* Ranges are given when sources quote different figures

[‡] Following proposed development, production is expected to rise to some 450-550,000 Ta₂O₅ lbs in 2009

Sources: Companies, [Global Capital Magazine](#) and [Engineering & Mining Journal](#)

In addition to these larger operations, further significant production flows from small and artisanal mining both in Brazil and in Africa; in particular, in the Democratic Republic of Congo (DRC), Mozambique, Namibia, Nigeria and Zimbabwe.

Tantalum Consumption

Having been mined, tantalum mineral concentrates are then shipped from the mines to concentrate processors. In 2008, 70-80% of tantalum concentrate consumption was attributable to just three groups: [Cabot Corporation](#) (owner of specialist Cabot Supermetals) of the U.S. (and owner of the Tanco tantalum mine in Canada), Germany's [H.C. Starck GmbH](#) and [Ningxia Non-Ferrous Metals Smeltery](#) in China. Of note among other such processors were [Mitsui Mining & Smelting](#) in Japan and [Ulba Metallurgical Plant](#) (UMP) in Kazakhstan.

Once the metal-bearing ores have been processed, the tantalum metal products - for example, powder and wire - are then shipped to the likes of capacitor producers AVX, Kernet, NEC, Hitachi, Vishay and Sanyo, to name just six. These, in turn, will supply such groups as Nokia, Dell, Motorola, IBM, Apple and HP.

The Tantalum Market

To describe the tantalum market as complex would, I believe, be an understatement. Here are just four of its complexities.

First, there is the admixture of the mining companies themselves. These range from the large (for whom activity in tantalum is just one of many); for example, Cabot Corp.; to the small, for whom tantalum is very much their lifeblood; for example, Noventa.

Production capacity does not necessarily, either, mean that a mine is publicly owned: The world's largest tantalum mineral ore producer in 2008 was Talison Minerals, a privately held Australian company that rose, phoenixlike, from the ashes of Sons of Gwalior. Ethiopia's Kenticha operation is state-owned.

Where mining operations are located is, also, no indication of their owner's location: [Metallurg](#), which operates the Mibra mine in Brazil, is owned by a privately held company based in the Netherlands.

Some operations are wholly owned, while others are joint ventures. Gippsland has only a 50% stake in the Abu Dabbab tantalum operation it is developing in Egypt. The remaining 50% is held by the Egyptian government.

Some Publicly Owned Tantalum Mining Companies And Selected Operations

<i>Market Cap (US\$:1/7/09)</i>	<i>Country/Mining Operation</i>	<i>Owner</i>	<i>Bloomberg Ticker</i>
1.041 Bn	Canada/ <i>Tanco</i>	Cabot Corporation	CBT:US
14.621 Bn	China/ <i>Nanjing</i>	China Minmetals (Co-owned with Shenzhen Jiuweihang)	600058:CH
11.552 Mill	Mozambique/ <i>Marropino</i>	Noventa Limited	NVTA:LN
957.1 Mill	Brazil/ <i>Pitinga (& Rocha Sã)</i>	Paranapanema SA	PMAM3:BZ
14.621 Bn	China/ <i>Yichun</i>	China Minmetals	600058:CH
32.345 Mill	Canada/ <i>Blue River</i>	Commerce Resources Corp.	CCE:CN
12.614 Mill	Egypt/ <i>Abu Dabbab</i>	Gippsland Limited (50%)	GIP:AU
11.552 Mill	Mozambique/ <i>Morrua</i>	Noventa Limited	NVTA:LN
2.059 Mill	Saudi Arabia/ <i>Ghurayyah*</i>	Tertiary Minerals plc (50%)	TYM:LN
9.283 Mill	Greenland/ <i>Motzfeldt</i>	Angus & Ross plc	AGU:LN
12.039 Mill	Australia/ <i>Bald Hill</i>	Haddington Resources Limited	HDN:AU

Developed and 'on-line'

Under advanced development (*development currently suspended)

Under early development

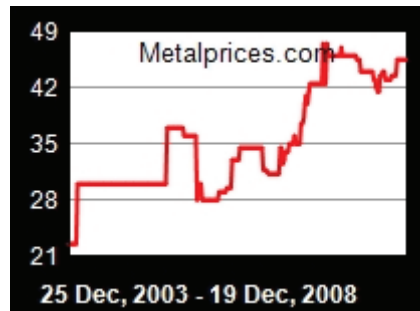
Exchange Rate GBP/USD:1.523/1

Second, as with many minor metals, since tantalum is not traded on any exchange, neither are there any published prices for the metal, its minerals or its chemical compounds, nor is there any great price transparency.

In general, the prices between both mines and processors, and for tantalum products, post processing, are established by negotiation. Indicative prices are, however, published by trade magazines. [*Mining Journal*](#) for December 19/26, 2008, gave a price for tantalum oxide (“60% N Euro port”) of \$45.5/lb.

While over the last five years such prices have been volatile, over the past year there have not been any really extreme price movements.

Tantalite Prices - 5 Years (\$/lb)



Source: MetalPrices.com

Third, there is the matter of inventories. When trying to judge the balance between the supply of and demand for any commodity, and especially minor metals, it is always useful to understand a little about inventory levels - both consumer and producer.

One fact we do know is that (as mentioned above), in 2007, the U.S. Defense Logistics Agency sold off all the country’s remaining inventories of tantalum. With these now gone and no more such sales to come, the question remains as to what the levels are of both consumer and producer inventories. While it is a question that remains unanswered, it is safe to assume that, currently, such inventories are now being drawn down.

Fourth, there is the issue of “blood” tantalum, or mine tantalum and coltan (columbo-tantalite), from the DRC (and, by extension, various surrounding countries; for example, Burundi, Congo, Rwanda and Zambia), available on the black market for considerably less than tantalum from legitimate sources.

In short, in a situation that has changed little since, in 2002, the United Nations released its “[Final Report of the Panel of Experts on the Illegal Exploitation of Natural Resources and Other Forms of Wealth in the Democratic Republic of the Congo](#)” in the country’s war-wracked east, rebel groups, various different militia groups and even members of the Congolese army still control and exploit extensive networks of illicit clandestine artisanal mines.

Not only are these mining activities illegal, they are also both appallingly destructive to the local social and physical environment, essentially raping the land of its mineral wealth, and often involve the severe abuse of those actually doing the mining, many of whom live as slaves.

Talison estimates that the DRC accounts for a large proportion of the tantalum ores produced in Africa. Indeed, in a [presentation it gave last September](#), it further estimated that the export of such ores from central Africa, particularly the DRC, would total some 900,000 Ta₂O₅ lbs in 2008, with the majority “destined for China.”

While there will, of course, always be unscrupulous (or, indeed, unwitting) purchasers who will buy such “tainted goods,” in the hopes of trying to curb black market activities in blood tantalum, there are now both an increasing number of global users looking with favor at establishing some sort of certification of origin process for the metal and its ores, and others who have undertaken, at the very least, not to buy tantalum from the various countries involved in the conflict.

Opportunities In Tantalum?

On November 26, 2008, in a move that must have come as some surprise to the market, [Talison announced](#) it was suspending mining at its tantalum operation in Wodgina.

Prior to this announcement, the 1.3 million Ta₂O₅ lbs produced by the mine in 2008 accounted for more than 30% of the world’s tantalum. In that the company’s Greenbushes operation (capable of producing some 1 million Ta₂O₅ lbs a year) has been on care and maintenance for the last three years, Talison has, for the time being anyway, effectively taken itself out of the tantalum market. And left a large gap.

The company cited both “a severe downturn in worldwide demand for consumer electronics, resulting in a lower demand for tantalum” and “a long-term and increasing trend to reduce material costs in the electronics supply chain, which strongly encourages increased tantalum supply from Central Africa, and particularly from the Democratic Republic of Congo (DRC).”

The company’s chief executive, Peter Robinson, ended the media release on a somewhat sinister note: “Without Talison’s supply the majority of the world’s tantalum will come from irregular and unreliable suppliers from politically unstable regions, with much of it coming from the DRC.”

Clinton Wood, however - who heads up one of Talison’s major competitors, Noventa - [put the reason why](#) rather more baldly: “In a recent development, the Company [Noventa] notes that the world’s largest producer of tantalum concentrate has indefinitely suspended its tantalum operations. It is understood that its customers were unwilling to renew their contracts due to the high asking price.”

Certainly Talison’s customers may, indeed, in its words “have sufficient tantalum for the near future,” but this will soon run out. The issue will then be where to source new supplies - supplies that are both stable and legitimate.

Even with the current downturns in demand for tantalum from both the electronics and automotive industries, with Talison’s departure from the market, the absence of any further sales from the U.S. Defense Logistics Agency, continuing drawdowns from tantalum inventories and increasing concerns about the provenance and “status” of tantalum feedstock, a supply shortage is highly conceivable.

Should such a supply shortage materialize, or perhaps even threaten so to do, it would certainly signal the need to look seriously at the mining companies either already able to offer stable, legitimate tantalum ore supplies on a long-term contract basis, or those with suitable projects that are at an advanced stage of development.

The corollary to this, however, is that many of these companies are not very highly capitalized, and it

remains to be seen if they have enough cash, or can raise enough cash, to weather the current economic conditions without going into “hibernation,” as has Talison.

Although there is some substitutability for tantalum, effectiveness is, generally, reduced. Therefore, whatever its size, there will always be a market for tantalum, whether in turbine blades, electronics or defense and medical applications.

While trying to unravel the knots of complexity in the world of tantalum may be as frustrating as Tantalus himself found it trying to grab the juicy fruit just above his head, in the real world, success *is* possible and could be very rewarding.

Afterwords

Continuing work on the use of advanced tantalum polymer capacitors in high-voltage power supply applications may eventually be of quite some importance in the development to hybrid vehicles, particularly when it comes to matters of costs.

Although recycled scrap has been an important source of tantalum, the economics of such recycling are dynamic, and there may come a time when such recycling becomes uneconomic, especially the smaller the recoverable amounts of tantalum become.

Resources

[U.S. Geological Survey \(USGS\)](#)

[Tantalum-Niobium International Study Center](#)

[Talison Minerals](#)

[Minor Metals Trade Association \(MMTA\)](#)

[Cabot Corporation](#)

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