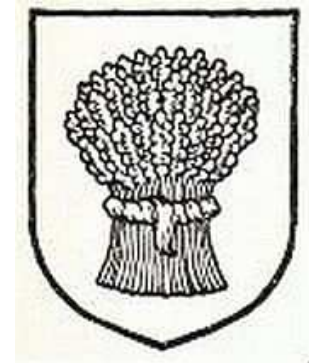


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HALLGARTEN + COMPANY

Sector Review

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Beryllium Review

One Metal the US Dominates

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Beryllium – Where the US Dominates

In recent years the panicked cry has gone up about US dependence upon foreigners for supply of the most strategic metals used in high tech and/or defence applications. However there is one metal that the US has a stranglehold on and it is Beryllium. When panic merchants begin their jeremiads, there is nary a mention of this metal. But it is the metal in which the US has most of the rest of the world at its mercy. This dominance should be a model for other metals but the doomsters in Washington would be unlikely to know that the US has this advantage.

Some Chemistry

Beryllium is the chemical element with the symbol Be and atomic number 4. It is a relatively rare element in both the universe and in the crust of the Earth. It is an element which occurs naturally only in combination with other elements in minerals. As a free element it is a steel-gray, strong, lightweight and brittle alkaline earth metal.

Beryllium increases hardness and resistance to corrosion when alloyed with aluminium, cobalt, copper (notably beryllium copper), iron and nickel. In structural applications, high flexural rigidity, thermal stability, thermal conductivity and low density (1.85 times that of water) make beryllium a sought-after aerospace material for high-speed aircraft, missiles, spacecraft, and communication satellites. Because of its low density and atomic mass, beryllium is relatively transparent to X-rays and other forms of ionizing radiation; therefore, it is the most common window material for X-ray equipment and in particle physics experiments. The high thermal conductivities of beryllium and beryllium oxide have led to their use in heat transport and heat sinking applications.

The main negative is that Beryllium is highly toxic when inhaled creating a much heightened propensity for lung cancer.

Production Metrics

In 2011, the world beryllium production reached more than 260.4 tonnes. In 2012, the global production of beryllium registered a 12.3% YoY decrease, declining to approximately 228.41 tonnes. The US is an unrivalled leader in the world beryllium market, with more than 87% share of the world beryllium output. Other important beryllium producing countries in the world include China, Mozambique, Brazil and Madagascar.

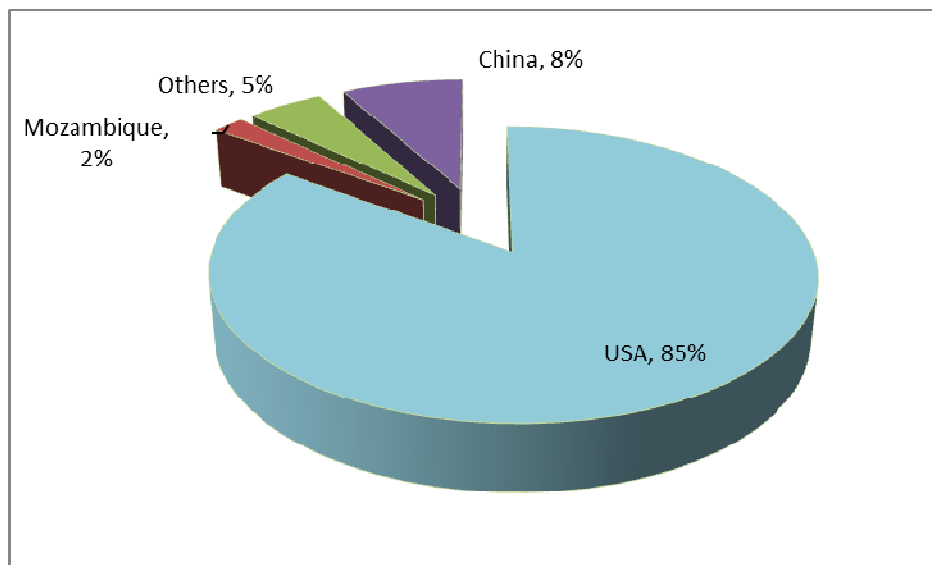
Currently, a new player is deepening its footprint in the global beryllium marketplace. In December 2011, Russia reopened its unique emerald-beryllium Malyshevsky mine in the Sverdlovsk region. The country is also increasing investments in its other mining and refining complexes.

The overall beryllium production might manage to pass the 300 tonnes of contained beryllium threshold by 2017. Demand fluctuates as we have seen as the level of US government stockpiling is a key swing factor. We would expect an uptrend though over coming years with rising consumption from the telecommunications, automotive electronics and computer industries. Some prognosticate a considerable increase in beryllium consumption in Latin America and Asia in the upcoming years. On the technological side the applications employing beryllium-containing alloys could make a significant contribution to the world beryllium market growth.

The US is forecast to remain the dominant market player in both consumption and production. The United States is the world's leading source of beryllium. The Spor Mountain mine in Utah produced more than 85% of the 230 tpa of beryllium mined worldwide. The production of beryllium in the US registered a 14.9% YoY decline in 2012 and decreased to 200 tonnes, compared to 235 tonnes in 2011.

China produced most of the remainder, and less than 2% came from Mozambique and other countries. Madagascar used to be an important producer in the 1990s but that has largely disappeared as a force.

Global Beryllium production by country, 2012



National stockpiles also provide significant amounts of beryllium for processing.

Total world reserves of beryllium ore are estimated to be greater than 400,000 tonnes.

Consumption

The domestic consumption for 2012 was estimated at around 220 tonnes. In the same year, the consumer electronics and telecommunications industries were the major beryllium end users, accounting for over 40% of the beryllium consumption volume in the US.

Three countries (China, Kazakhstan, and the United States) process beryllium ore. In 2005, the U.S. Department of Defense began a partnership with Materion to build a new processing facility in Ohio to produce high-purity beryllium metal. The processing facility was completed in 2011, and up to two-thirds of its output was to be allocated for defense and other government-related end uses.

The United States imported approximately 34% of the beryllium raw materials it used in 2011, including beryllium metal and other processed beryllium materials used in manufacturing; two-thirds of this material came from Russia and Kazakhstan.

The trend (at least up until 2010) reported by the USGS indicated strong demand. In the first half of 2010, Materion reported a 62% increase in shipments of bulk beryllium-copper alloy products, compared to the first half of 2009. Beryllium product sales in the key markets of aerospace, automotive electronics, ceramics, computers and telecommunications were substantially higher than the previous year. Recently though the demand has levelled off with sale revenues essentially flat from 2010 to 2012.

Pricing

Pricing is usually set between the mine and the production facility based on the usual factors of supply and demand. Increased demand led to increasing prices for beryllium over the last decade. Based on the beryllium content in imported beryllium-copper master alloy, an alloy for which there is a reliable reported price, the USGS estimated the average annual unit value of contained beryllium in beryllium-copper master alloy US\$/lb as:

2006	2007	2008	2009	2010
\$128	\$144	\$159	\$154	\$230

Source: U.S. Geological Survey, Mineral Commodity Summaries, January 2011

The Players

The names to conjure with in the mining and processing of Beryllium are Materion (Ohio/Utah), IBC Advanced Alloys Corp. (Canada but plants in US), Belmont Metals (New York), Applied Materials, NGK Metals Corporation (Tennessee), American Beryllia (New Jersey), Esmeralda de Conquista Ltda (in Brazil), Ningxia Orient Tantalum Industry Co (China), Fuyun Hengsheng Beryllium Industry Co (China), and Grizzly Mining Limited (a Zambian gem miner).

Materion (MTRN)

The 800-lb gorilla in the Beryllium space (not to mention being the “anointed” of the Pentagon) is Materion, the specialty metals processor which also owns the aforementioned Spor Mountain Mine. As

such t is the world’s only integrated “mine-to-mill” supplier of beryllium-based products. The company used to be known more prosaically as Brush-Wellman (before that the Brush Beryllium Company).

While being the owner of the important mine it is mainly a producer of beryllium-sourced products. These include precious and non-precious specialty metals, precision optical filters, inorganic chemicals and powders, specialty coatings and engineered clad and plated metal systems.

The strategic importance of Beryllium is evidenced by some of the high tech output of Materion as evidenced by sophisticated thin film coatings for hard disk drives, specialty inorganic chemicals for solar energy panels, bio-compatible materials for implantable medical devices, specialty alloys for miniature consumer electronics components, optical filters for thermal imaging, critical components for infrared sensing technology and special materials for LEDs. It’s worth noting that Materion is a supplier to the Defense Logistic Agency (DLA) stockpile.

The Beryllium deposit at Spor Mountain was initially mined by Brush Wellman beginning around 1970. The company is thought to mine 1% grade BeO ore at Spor Mountain (and reports 75 years of reserves at current mining rate). Ore is mined from linear open pits that follow the strike of the tilted ore-bearing tuff. Deposits are mined to shallow depths (very approximately, 30-50 m). Depth is limited by the cost of stripping hard rhyolite caprock.

The techniques used for mining beryllium-bearing ore from this property are considered unique, because of the requirements that must be met to identify the ore body and the rock materials overlying the ore. The beryllium mineralization contained within the tuff member produces no visible physical characteristics which aid in identifying the presence of mineralization as the beryllium mineralization is colorless and its crystal structure is too small for recognition by the naked eye.

A detailed mining operation is employed utilising procedures to follow in survey control, use of cross sections, structure contour maps, and field beryllometer. The beryllium ore is mined from selected or predetermined areas of the ore body, placed in the stockpile in layers as blocks on top of each other. This method has been successful in producing a homogeneous blend acceptable as mill feed.

When it recently announced its 1Q14 results it also confirmed its earnings guidance for the full-year 2014 of \$1.75 to \$1.95 per share.

Texas Rare Earths - Beryllium Plug & Play

Texas Rare Earths is the owner of the Round Top Mine in Texas which is a *wunder-mine* that is all things to all investors. It has Rare Earths, Flourite, Lithium and Uranium. However it was



originally developed as a Beryllium deposit. Most of the work on this score was done in the past by Cabot Corp and Cyprus Minerals.

The current situation at Round Top is the efforts of Cabot and Cyprus left not only a data-set on the deposit but also physical infrastructure in the form of a “starter mine” (still usable and pictured at the right) consisting of a 867 ft long, 10ft x 10ft decline with vent fan & services in place.

The Cyprus mine plan dating from 1988 is in the possession of TRER. Round Top represents a high grade mineralization – 300,000 tons at 2% BeO (not NI 43-101 compliant). The latest PEA envisages 36 tpa of BeO production. This would represent 7.4% of global production. Before one dismisses the relative puny size of this production one should note that the metal is currently trading on the Shanghai Metals Exchange at \$374,000 per tonne.

Beryllium represents an interesting Phase Two (or Three) exercise for TRER.

IBC Advanced Alloys – (IB.v)

IBC Advanced Alloys is a rare metals advanced alloys developer and manufacturer of beryllium copper, chrome zirconium copper, chromium copper alloys, nickel aluminum bronze, copper rod, and other alloys of copper. It also makes high-performance beryllium aluminum castings. These high technology products are used in a broad range of market sectors including nuclear power, automotive, oil and gas, electronics and aerospace. The company also undertakes R&D initiatives focused on enhancing and supporting IBC's growing US manufacturing base.

It has several mining properties it has explored in Utah (adjacent to Spor Mountain), Colorado (includes the Boomer Mine – second-largest historical beryllium mine in the US) and also in Brazil (Minas Gerais). Most effort has been expended on the 7,500 acres it staked at Spor Mountain. The last major work there was in 2011 when the company undertook a program that consisted of 35 reverse circulation holes. The company reported that no ore-grade BeO was encountered. This was a blow which seemingly sent the company's Be exploration efforts into hibernation but we are surprised that the more prospective Boomer property has not been subject to exploration work. The Boomer mine produced a majority of the beryllium ore mined in Colorado from 1948 until 1969 and over 50% of the total US production during that period according to the U.S. Bureau of Mines Minerals Yearbooks. Mining operations were discontinued in the early 1970s due to a legal dispute between the operating partners.

BE Resources (BER.v)

This is more a case of what might have been. BE Resources is a mineral exploration company incorporated in 2007 to explore and evaluate a significant beryllium target in New Mexico, USA. It secured a 100% interest in the Warm Springs property in Socorro County which comprises about 520 acres. In addition to Warm Springs, the company also obtained three other state leases and over 1200 mining claims in Socorro and Sierra Counties. Together with the Warm Springs property, it accumulated an interest in an area of about 25,000 acres (10,000 hectares). The website of the company is seemingly moribund and there were some announcements about heading towards graphite in Quebec in January of this year. So it is unclear if the Beryllium interest has gone out the window in a focus-shift.

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Avalon (AVL.to) – Oops, missed

We might also note in passing that Avalon Rare Metals holds territory at Spor Mountain where drilling in 2012 found nothing of interest.

Conclusion

The dominance of the US in Beryllium is a good thing. This could be further accentuated by development of a second mine, Round Top, owned by TRER. Maybe life could be breathed back into the Bommer Mine. The US is clearly the axe in this metal but still remains dependent upon imports for too much of its industrial conversion. One could look at the US and Beryllium as somewhat like the Japanese and Rare Earths. In Japan there is a heavy concentration of the conversion of these REE oxides into end-use products. The US, by dominating Be mining, has managed to still retain an overwhelming role as the “go-to-guys” for Beryllium oxides and other by-products. The fact that the US stockpiles this product when it has let its grasp slip on so many others is rather telling.

The potential is clearly good here for the US and the “industrial-military complex” to maintain and build upon this dominance. And maybe it should be lesson in what might be done with other metals, such as REEs, Gallium, Tellurium and Germanium.

Important disclosures

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