

# Scandium – the Outlier Rare Earth

✘ When the Rare Earth boom was in full flight the universe was dictated to be the Lanthanide series plus Yttrium PLUS Scandium. This was generous of the promoters as Scandium was nowhere to be seen in their mineralisations so they were essentially giving a free plug for someone else's product. However it was a bit of safe bet as no-one we can recall was making any claims to having a Scandium resource. The metal was regarded as something that was produced "somewhere in Russia" and thus not something to easily wrap one's brain around let alone get one's hands on a deposit. With the global trade estimated to be around 100 pounds of pure metal per annum, it was not something to hold one's breathe over. Intriguingly though we have heard Scandium described as a "spice metal", which is a new one for us!

**A Bit of Background:** Scandium is a chemical element with symbol Sc and atomic number 21. A silvery-white metallic element, it has historically been sometimes classified as a rare earth element, together with yttrium and the lanthanoids. It was discovered in 1879 by spectral analysis of the minerals euxenite and gadolinite from Scandinavia, hence its name. In terms of earth's crust, Scandium is not particularly rare. Estimates vary from 18 to 25 ppm, which is comparable to the abundance of cobalt (20–30 ppm). Scandium is only the 50th most common element on earth (35th most abundant in the crust).

**Usage:** The main application of scandium by weight is in aluminium-scandium alloys for minor aerospace industry components. The positive effects of scandium on aluminium alloys were discovered in the 1970s. These alloys, composed of as little as 0.5% scandium, make a significant difference in strength. Scandium-stabilized zirconia enjoys a growing market

demand for use as a high efficiency electrolyte in solid oxide fuel cells.

One area that intrigues us is the Sc<sub>2</sub>O<sub>3</sub> that is used annually in the United States to make high-intensity discharge lamps. Scandium iodide, along with sodium iodide, when added to a modified form of mercury-vapor lamp, produces a form of metal halide lamp. This lamp is a white light source with high color rendering index that sufficiently resembles sunlight to allow good color-reproduction with TV cameras. About 80 kg of scandium is used in metal halide lamps/light bulbs globally per year. This would seem to be an application where a greater, more reliable supply of the metal might result in a significant expansion in usage, particularly into more household applications. We could also see potential in sports arena lighting.

Scandium also has uses in sports equipment, guns and dental inputs. Some of its applications can be substituted with Titanium.

**Production:** Scandium is distributed sparsely and occurs in trace amounts in many minerals. Rare minerals from Scandinavia and Madagascar such as thortveitite, euxenite, and gadolinite are the only known concentrated sources of this element. Thortveitite can contain up to 45% of scandium in the form of scandium oxide.

Scandium is present in most of the deposits of rare earth and uranium compounds, but it is extracted from these ores in only a few mines worldwide. Because of the low availability and the difficulties in the preparation of metallic scandium, which was first achieved in 1937, it took until the 1970s before applications for scandium were developed.

World production of scandium is in the order of two tonnes per year in the form of scandium oxide. The primary production is 400 kg while the rest is from stockpiles of Russia generated during the Cold War. These stockpiles are bound to be

exhausted within the foreseeable future, and alternative sources are therefore likely to be needed.

In 2003, only three mines produced scandium:

1. the uranium and iron mines in Zhovti Vody in Ukraine
2. the rare earth mines in Bayan Obo, China
3. the apatite mines in the Kola peninsula, Russia

In each case, scandium was a byproduct from the extraction of other elements. It should be noted that the Kola peninsula mines were the main source of product for Molycorp's Silmet facility in Estonia and also that these mines are now in terminal decline (if not already shuttered).

**Prices:** The current price of the metal is somewhat murky (like so many of the minor specialty metals) with indications that it trades at around US\$3,700 per kg.

#### **Some Names to Conjure with –**

Focus Metals (TSXV: FMS, OTCQX: FCSMF) has a substantial stake (40%) in Grafoid Inc., which recently announced it was acquiring ALCERECO Inc., which is involved in advanced composite materials, alloys and coatings focused on the development, testing and production of advanced materials. Grafoid purchased ALCERECO in exchange for 250,000 common shares of Grafoid for CAD\$1,250,000.

Based in Kingston, Ontario, ALCERECO has a global customer base in aerospace, automotive, electronics, sporting goods, infrastructural and mining sectors. It is involved in the development of aluminum-scandium alloys, specialty ceramics, rare earths and advanced composite materials. Its facility includes a five-ton foundry, casting, rolling, a wide range of development laboratories, and analytical equipment for the development of prototype production.

Recently EMC Metals (TSX: EMC) was brought to our attention as a Scandium play. It had been the owner until September of last

year of the Springer Tungsten mine and other assets in Nevada which it vended away to American Bullion Royalty Corp. Now its theme is as a specialty metals mining group with its operational focus is on scandium project holdings, specifically the Nyngan Scandium project in Australia and the Tordal Scandium project in Norway. However, EMC is not the only way to play Nyngan because it's an earn-in from Jervois Minerals (ASX: JRV).

The Nyngan scandium resource is located approximately 500 kilometers northwest of Sydney, Australia. It has in its time been trawled over by such substantial (now disappeared) players as Selection Trust, North Broken Hill and Anaconda. The property consists of two exploration licenses encompassing over 9,000 hectares, and is accessible via a 25 km sealed road from the local town of Nyngan.

The deposit is large and the grades are fantastic. Nyngan might be described as the "Bayan Obo of Scandium". The JORC-compliant resource estimate at Nyngan consists of a Measured Resource of 2,718,000 tonnes at 274 ppm Sc and an Indicated Resource of 9,294,000 tonnes at 258ppm Sc. Preliminary mine plans are musing about a CapEx of under US\$100M and an OpEx of under US\$1,000/kg (overall recoveries of >80%). This would produce around 15-30 tpa of Scandium with a product grade based on customer need (97-99.9%). The company hopes to make the plant scalable upwards.

The licenses, the mineral rights and the surface rights are controlled by Jervois Mining until final payments are made by EMC as per the 2013 settlement agreement. The terms of the settlement require EMC to pay Jervois AUD\$2.6M cash over 18 months, for a 100% position in the Nyngan project, including the land and mineral license rights. The first of those two cash payments have been made, with the second AUD\$1.4M payment due in June 2014. In production, EMC must additionally pay Jervois a 1.7% NSR on scandium produced, for 12 years from first production. Jervois is one to keep an eye on also in

case EMC cannot make the final payment and the asset reverts to Jervois.

Then there is Metallica Minerals (ASX: MLM) which holds the SCONI Project located in North Queensland, approximately 250km roads from Townsville. This consists of a number of scandium-rich lateritic deposits. The three main deposits in the southern area of SCONI are Greenvale, Lucknow and Kokomo.

Metallica Minerals completed a Pre-Feasibility Study in early 2013 to produce over 50 tpa of high-purity scandium oxide over a 20-year mine-life. The resource on the deposit consists of a Measured Resource of 539 tonnes of Scandium Metal, an Indicated Resource of 2,560 tonnes and an Inferred Resource of 728 tonnes. This is equivalent, in total, to 5,741 tonnes of Scandium Oxide.

The PFS demonstrated that SCONI Phase 1 to be technically and operationally viable with positive economics. Metallica planned to move into the Definitive Feasibility Study but due to tough market conditions in late 2013 and early 2014 the DFS has been deferred until appropriate funding is in place.

In both the cases of Metallica and EMC, to get the ducks to line up the companies will need to find an offtaker and frankly we suspect they will need to downsize (right-size as Jack Lifton would say) the production to fit to global demand. In both cases the companies are talking of annual production equal to or greater than global demand so they could easily sink the price of the metal in the absence of new applications. Then again they might prove to be a stimulus for higher usage considering that supply has been so tough to secure in recent years in guaranteed quantities.

**Conclusion:** The absence of reliable, secure, stable and long term production has limited commercial applications of scandium. Despite this low level of use, scandium offers significant benefits. The potential for substantial expansion

in usage and demand clearly exists and to an extent it is one of those "rare" metals stories where the supply could potentially generate the demand rather than the other way around.