Creamer Media's MINING WEEKLY Online

Investors take closer look at rare earth elements as technology, green revolution pick up pace

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Published: 18th September 2009

Plucked from obscurity owing to growing demand, the world's 16 rare earth elements (REEs) are a bit of a conundrum.

For one, they are not actually rare. They are found in much higher quantities and much greater concentration than precious metals such as gold or platinum.

However, despite this, they are a bit difficult to come by as one country – who else but powerhouse China – currently accounts for 95% of REE production, with the Asian country growing less willing to share with the rest of the world.

China last year produced 139 000 t of refined rare earth material.

The Asian country aims to ensure supply for its own needs first, which is why it reduced the amount of rare earths which could be exported in each of the last three years.

This has caused some alarm in the rest of the world.

REEs are the stuff the modern future is made of. They are the ammunition for the weapons of technology and the green revolution.

They are vital in the manufacturing of hybrid cars, super alloys used in the defence industry, cellphones, large wind turbines, missiles and computer monitors – think chic accessories such as the iPhone and the Prius.

China currently sets quotas for the annual export of each REE, and the rest of the world is becoming increasingly nervous that they may very well be steering closer and closer to zero exports.

By limiting exports, China is not only forcing manufacturers from abroad to set up shop in the country, but it is also chasing up the price of these minerals.

The good news is that South Africa also has a potential REE mine: Steenkampskraal, west of Loeriesfontein and Nieuwoudtville, in the Western Cape.

This mine is about to be developed, pending the necessary government approvals.

Dysprosium, Terbium, Yttrium . . .

The term REE is often used to generally describe rare earth elements and rare earth metals, explains Great Western Minerals Group (GWMG) investor relations manager **Ron Malashewski**. (The range of REEs is called by various names: rare earths, rare earth minerals or metals, or even rare earth oxides. For the purpose of this article, Mining Weekly will refer to them as rare earth elements.)

REEs have many obscure, but also interesting and vital, uses.

Terbium is put to work to make alloys and phosphors used in lamps and television tubes. It is also used to make computer monitors.

Dysprosium and terbium are used to manufacture very powerful but lightweight magnets.

Either or both minerals are added to high-tech magnets to help them stay magnetic, even at high

temperatures.

Many magnets tend to lose their magnetism as they heat up, but a little dysprosium or terbium prevents this from happening. This means dysprosium is used increasingly in permanent magnet motors in hybrid cars or wind turbines.

It is also used in nuclear reactor cooling.

Neodymium is also used in hard drives in laptops, and headphones in Apple's iPod. Each Toyota Prius also requires around 1 kg of this element, as well as 10 kg to 15 kg of lanthanum.

Yttrium and europium are used to generate red on colour television and computer monitor screens. Yttrium is also added to aluminium, and europium to vanadium.

Ytterbium is used in the solar power industry.

In 2006, the three main uses for REEs in the US were automotive catalytic converters (25%), petroleum refining catalysts (22%), and metallurgical additives and alloys (20%).

Former General Motors global commodity manager **Ivan Herring** expected at the end of 2007 that the use of REEs in alloys would grow from 8 500 t in 2005, to 15 700 t in 2010. In battery applications, such as in hybrid vehicles and nuclear-powered batteries, he expected it to jump from 7 200 t to 27 300 t in 2010, and in auto catalysts from 5 800 t to 7 600 t.

In ceramics, Herring expected use to grow from 2 000 t in 2005, to 2 900 t in 2010, and from 800 t in laser applications in 2005, to 1 500 t in 2010.

In the magnet industry, demand was expected to grow from 17 200 t in 2005, to 30 000 t in 2010, and in the medical field from 100 t to 1 100 t in 2010.

Mischmetal (from the German for mixed metal) is an alloy of REEs in various naturally occurring proportions. A typical composition includes around 50% cerium and 25% lanthanum, with small amounts of neo- dymium and praseodymium.

Its most common use is in the flint ignition device of many lighters and torches, although an alloy of only rare-earth elements will be too soft to give good sparks. For this purpose, it is blended with iron oxide and magnesium oxide to form a harder material known as ferrocerium.

Mischmetal is also used as an addition to steel to improve heat resistance.

In 2007, Herring expected mischmetal use to grow from 900 t in 2005 to 1 100 t in 2010.

All in all, REE demand is expected to exceed supply by 40 000 t by 2015, should no new resources be uncovered.

Malashewski says there are only a handful of private or publicly traded companies active in the global REE exploration sector, with the rest located in China, and owned by the Chinese government.

Aside from GWMG (based in Canada), these include Avalon Rare Metals (Canada), Molycorp Minerals (US), Lynas Corporation (Australia), and Arafura Resources (Australia).

However, State-owned Chinese companies are in the process of buying 25% in Arafura Resources, which the Australian government has already approved, and a nearly 52% stake in the Lynas Corporation – a deal which the Australian government is still reviewing.

One public company mining REEs as by-products is Alkane Resources (Australia).

Public companies that are working on rare earth projects are Rare Element Resources (US) and Navigator Resources (Australia).

In the specialised REE alloy sector in Japan, there are three principal producers – Santoku Corporation, Showa Denko KK and Shin-Etsu – and only two smaller-scale producers, Nippon Yttrium and Sumikin Molycorp.

Supply and Demand

The demand for REEs is expected to con- tinue growing, because of the growing appetite from specialised applications, particularly in the battery and magnetics sectors, says Malashewski.

“With the anticipated increased production in hybrid/electric vehicles, and the growing demand for wind turbines, the projected near-term demand is expected to outstrip supply,” he confirms.

When talking demand and supply, there are many complexities in the market, adds SRI consulting senior consultant **Ray Will**.

SRI Consulting is a US-based business research service for the international chemicals industry.

“There are many political and technological considerations when forecasting rare earth oxides demand.

“There is also a variety of different oxides that are produced, and some are in short supply, and some not.”

Will says some REEs may be popular one day, and then fall out of use, which makes the market somewhat fluid in nature.

For example, will hybrid vehicles continue growing in popularity?

“The future of REEs is good as long as demand remains strong for batteries used in hybrids, as well as automotive catalysts and flat-panel displays,” says Will. “And there are probably six flat panels looking at you right now.”

What he is referring to are cellphones, new-age refrigerators, computer screens, television screens, Nintendo gaming systems, iPods and other gadgets with flat screens, with many other examples around.

China’s vice grip on REEs is also contri- buting to a potential supply problem – the political complexities Will alludes to.

The current supplier of more than 95% of these elements has given some preliminary indications that it will further cut back exports to the rest of the world to meet its internal needs.

“China has already reduced exports and imposed tariffs on what is being shipped out,” explains Malashewski.

“This has caused tremendous concern among the major end-users of REEs, since they need security and stability of supply.

“In addition, there are only a handful of REE exploration companies around the world.”

The Chinese Puzzle

US-based energy investment specialist **James Kingsdale** also blames the Chinese market for a possible supply shortage.

“There was very little public attention paid to this vital, strategic group of metals until recently when the Chinese began to make a power play by restricting exports in an effort to force companies using REEs to open manufacturing plants in China.”

Will says China is “highly motivated” to add value and export finished goods rather than raw materials.

“One thing is clear, the political situation in China could determine how valuable rare earth oxides become as a group.

“If China has its way, and it withholds rare earth oxides from trade, all deposits outside China will become far more valuable.”

China is already in a bit of hot water with the World Trade Organisation (WTO) for what the European Union (EU) and the US say are restrictions on the export of commodities such as fluorspar, magnesium and bauxite, through quotas and export duties.

These restrictions are said to distort competition and increase global prices, as some of these resources cannot be found in sufficient quantities elsewhere.

The EU and the US have asked for con- sultations with China at the WTO.

“If there are already talks around rare earth oxides, the WTO and China, it means there probably are already injured parties,” notes Will.

REEs are not traded on structured commodity exchanges similar to other commodities.

The prices are usually negotiated between suppliers and the end-users.

Several years ago, REE prices were driven down by volume production from China, says Malashewski.

As a result, it was not viewed economically viable to bring any other properties into production.

That is one of the main reasons why there are so few other REE mines outside China.

However, says Malashewski, since “the demand for REEs has been increasing and supply decreasing, the prices are increasing”.

This said, though, REEs have not been immune to the global financial crisis.

“Prices have been increasing through to mid-2008,” explains Will.

“Mischmetal prices went up 50% from 2005 to 2008, for example.”

However, prices started to fall in tandem with the economic crisis, but are now ticking up again, he notes.

Prices for REEs were indeed still strong in 2008, particularly for lanthanum, which rose from $6/kg to $13/kg, but then dipped back to $6,34/kg in July this year.

Terbium currently sells for $360/kg. Dysprosium moves for around $110/kg. Europium sells for $481/kg, and thulium for $790/kg.

The cheapest REE is cerium, at $4,82/kg.

Kingsdale says total REE demand is expected to double over the next five years.

However, it is not all bad news. He expects the mining industry to react to the expected demand.

“China has the largest deposits, but as market prices for REEs rise, other deposits in other parts of the world – North America, Asia, Australia – will be developed and brought to market.”

Emerging from Obscurity

Have investors woken up to the potential of rare earth elements?

“Very much so, and mostly in the last few months,” says Malashewski.

“The REE sector does not have the same glitz as gold and base metals. Most people don’t understand it, and very few follow it.

“There are so few participants in the sector that it would be possible to imagine that a few months ago the total market capitalisation of all global REE exploration companies combined would probably be the same as – or less than – the total market cap of a midtier Canadian gold producer.

“That has changed.”

Malashewski says part of the new-found attention from the investor community seems to be focused on the fundamentals surrounding REEs, and the realisation that there are some serious supply issues emerging.

“Earlier this month there was word that the Chinese government had a draft of an REE policy prepared which recommended further cutbacks in their exports. This was just a draft report, and whether it becomes reality remains to be seen.

“The news of this report further stimulated interest in the importance of REEs and an impending shortage.”

Is the growing publicity around REEs leading to increased funding for the sector, though?

Malashewski says funding was difficult for all but the most advanced mineral exploration companies and projects since last August, to around April this year.

“However, since April, sources of capital were becoming more interested in financing, and with the attention paid to the REE sector in the last few months, that interest has increased significantly.”

The biggest REE mine under development outside China is one owned by Molycorp Minerals, which plans to

reopen its Mountain Pass openpit mine in California in 2012.

Lynas is also working on its Mount Weld project, in Australia, with Arafura Resources progressing work on its Nolans project, also in Australia.
GWMG Hoidas Lake project, in Canada, also counts as one of the largest, as does Avalon Rare Metals' Thor Lake project, also in Canada.

Anywhere but China

REEs deposits vary tremendously, explains Will.

Each deposit has a different complement of REEs, so owning a REE deposit does not necessarily mean one has the most sought- after elements in the mix.

GWMG has several projects at various stages of advancement. Its main aim is to develop resources outside China.

Hoidas Lake is located 50 km north-east of Uranium City, in northern Saskatchewan, Canada. This is an advanced property with a proved resource which is being further developed, says Malashewski.

The Deep Sands project is a 168-km2 iron and rare-earth-element-enriched mineral sands project in Utah, in the US.

Two drilling programmes have been completed and data evaluation is in progress.

The Douglas River property, in Canada, consists of two claims (totalling 803 ha), about 21 km south of the former Cluff Lake uranium mine.

Historical trench sampling yielded REE grades of up to 10% yttrium with accompanying high grades of heavy rare earths, including dysprosium, with grades of up to 0,89%.

The Benjamin River rare earth element project is located 53 km west of Bathurst, New Brunswick.

In July this year, GWMG signed a letter of intent with Toyota Tsusho Corporation to examine the merits of jointly conducting exploration and development activities on GWMG's Douglas River and Benjamin River exploration projects.

Dysprosium is the most sought after of all REEs, and especially so by the Japanese for magnet manufacturing, used in hybrid vehicles, says Malashewski.

GWMG's Misty property consists of a single exploration licence in north-west Manitoba, also in Canada.

And South Africa?

GWMG is also in the early stages of developing a REE mine in South Africa – Steenkampskraal, in the Western Cape.

In January this year, the Canadian company entered into an option agreement with Rare Earth Extraction Company (Rareco) of Stellenbosch, to refurbish, recommission and operate the currently abandoned underground mine.

"Although GWMG's other properties are in North America, the corporate objective is to develop a portfolio of properties outside China's influence," says Malashewski.

"This particular project was presented to GWMG and generated sufficient interest for further evaluation."

Under the terms of the agreement, GWMG has agreed to pay Rareco R1-million for this option, payable in two tranches.

The first payment of R500 000 was paid on signing the agreement.

The second payment will be made upon delivery, by Rareco, to GWMG, of an updated feasibility study, and the conversion of its current old-order mining rights to a new mining licence, valid under the new political dispensation.

The application for conversion was sub- mitted to the Department of Mineral Resources on April 28.

Malashewski says the updated feasibility study on Steenkampskraal is nearing completion, and is expected

to be submitted by the end of September.

Subject to approval by GWMG of the updated feasibility study, and other due diligence information to be provided by Rareco, GWMG and Rareco look set to negotiate a supply agreement under which 100% of the rare earth ore mined and pro-cessed will be made available by Rareco to GWMG for a ten-year period, following which a new supply agreement can be negotiated.

The framework of this agreement includes the introduction of a black empowerment partner in the ownership structure of the mining operation.

Malashewski says Rareco is currently in negotiations with a major mine operator in South Africa that qualifies as a black eco-nomic-empowerment partner, while, at the same time, bringing considerable mining expertise to the project.

“GWMG’s participation in the project may take the form of either equity or debt, or a combination of the two.”

The existing Steenkampskraal mining licence covers 474 ha. The property is located about 70 km north of the town of Vanrhynsdorp, with a population of 4 000.

It is about 350 km from Cape Town.

The main rare-earth-bearing mineral is monazite, and is hosted by an igneous intrusive dyke system. The mineral deposit is tabular in shape, with a known strike length of 400 m.

Monazite contains lanthanum, cerium, praseodymium, neodymium, samarium, europium, yttrium and gadolinium.

The average in situ grade is 16,74% total rare earth oxide, making it one of the highest- grade rare earth deposits known to exist, says Malashewski.

The deposit also contains significant amounts of copper, gold and phosphate which can be recovered as by-products.

However, adds Malashewski, very little exploration work has been done on the property.

Historic underground REE mining operations deposited run-of-mine waste rock on the surface of the property, as well as tailings from the processing plant.

Sample grades of the tailings and waste rock indicate that, historically, both would qualify as resource tonnage for rare earth production.

In addition to the remaining in situ material, there is rock that was blasted, but not hauled to surface.

Some of this rock was historically con-sidered as low-grade material, and was used as ballast for the underground railroad track used to support the mined rock being hauled to surface.

The minerals at Steenkampskraal are primarily REEs, but there may be a thorium by-product.

Thorium can be used as a uranium sub- stitute in nuclear power reactors.

Supply Chain Plans

Malashewski says GWMG has bigger ambitions than to be a mere REE-miner.

“We have a pipeline of customers already. GWMG’s strategic plan is to become a fully vertically integrated, mine-to-market company.

“We already have revenue generating production facilities in Troy Michigan, in the US, and in Birkenhead, in the UK. With those facilities our strategy is to become the supplier of raw materials to our own production facilities. Currently, we source our raw materials from China, like the rest of the users.

“These production facilities already have an established base of large global end-users, including Aichi Steel, which is a member of the Toyota group of companies.”

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