# The Crucible

## European Rare Earths Production

## Magnesium Metal Market Overview

## INSIDE THIS ISSUE



## CONFERENCE SPONSORS:

# MMTA'S INTERNATIONAL MINOR METALS CONFERENCE, 27th-29th APRIL 2014, VICTORIA PARK PLAZA, LONDON

We anticipate another sell-out conference, with bookings already ahead of previous years for THE minor metals conference of 2014.
We have a first class programme of speakers:

**28th APRIL—Guest speaker: Mark Miodownik, Professor of Materials & Society at University College London, University of London, United Kingdom;**

**Keynote presentation** — "China: Great expectations?" **by Dennis Unkovic, Partner, Meyer, Unkovic & Scott LLP, USA;**

### Session 1: Automotive and aerospace:

"Sourcing critical metals and raw materials for the automotive industry: Latest developments for electric, hybrid and low carbon emission vehicles", **by Philippe Schultze, Expert Leader Environment-Energy-Strategic Raw Materials, Direction Strategie & Plan Group, Renault SA, France;**

Is magnesium on the threshold of dynamic new applications in both aero-space and automotive?, **by Graham Wardlow, Managing Director UK Operations, Magnesium Elektron, United Kingdom;**

"Recovery of rhenium in Poland", **by Kamil Kozub, Production Manager, KGHM Group, Poland;**

### Session 2: Recycling and secondary:

"Latest developments in minor and electronics metals recycling", **by Christina Meskers, Business Development, Umicore Precious Metals Recycling, Belgium;**

"A day in the life of a specialty metals scrap yard", **by Duncan Birchley, Sales & Marketing Executive, Select Alloys & Materials Ltd, United Kingdom;**

***15.15 MMTA AGM***

***19:00-21:00 Tate Britain Reception – join us for canapés & drinks at Gallery 9 at the newly reopened Tate Britain kindly sponsored by Lipmann Walton Ltd***

### 29 APRIL—Session 3: Markets in steel, specialty and stainless:

**Keynote presentation** – "Global trends for specialty, tool and stainless steels", **by Marcus Moll, Managing Director, SMR, Austria;**

"Vanadium market overview: Rebar, redox – reasons to be optimistic?, **by Jack Bedder, Senior Analyst, Roskill Information Services Ltd., United Kingdom;**

### Session 4: Refractory metals and applications:

"Hafnium and zirconium: Growing demand in alloys?" **by Cyrille Rontard, AREVA – Fuel Zirconium Sales, France;**

"Minor metals in catalysts", **by Andrew Hinkly, Executive Head of Commercial, Anglo American Platinum, United Kingdom;**

"New applications for antimony: Challenges/potential in the flame retardant market", **by a senior representative of Campine, Belgium;**

"Fanya Exchange: Its role in the global minor metals industry", **by Zhang Peng, Vice President, The Fanya Metal Exchange, China;**

## MESSAGE FROM THE EXECUTIVE TEAM

Welcome to the latest edition of the Crucible. As you will see, we have been extremely busy setting up what we hope will prove to be interesting partnerships and benefits for MMTA members, as well as putting together our first quarter's events programme.

We are again offering the Import Training Course, the first of this year's professional development courses, so for anyone wishing to learn more from either a trading or shipping perspective, this will be 2 days well spent.

The highlight of the calendar is our International Minor Metals Conference. As you will see, we have an excellent line up of speakers, as well as visits to the LME and Rolls-Royce, and a Reception at the wonderful Tate Britain Gallery, sponsored by Lipmann Walton in support of the CMCPT charity working with the community in Mufulira, Zambia.

I would like to remind you that this year's AGM will take place during the conference—all members are encouraged to attend and hear about the activities of the various MMTA committees. We very much hope to see you there.

Finally, if you would like to advertise in this year's Annual Review, please contact Maria or Tamara.

## VISIT TO ROLLS-ROYCE, DERBY

## 30th APRIL 2014

**To round off the MMTA conference, Rolls-Royce has kindly offered to host the MMTA at its heritage centres in Derby.**

Take the coach with us from London Victoria for the tours and lunch, returning to London by early evening.

The first tour is an overview of the Rolls-Royce story from its beginnings to present day product range.

We will then be taken by coach for a three-course lunch with wine.

After lunch, there will be a tour of the Light Alloy Foundry, where we will see the largest collection of aero engines in the country, ranging from World War 1 era piston engines, the famous Merlin, right up to modern day jet engines. The collection also includes examples across Rolls-Royce's product range including marine and industrial applications. There are a small number of vintage cars, some of which hark back to the early days of Rolls-Royce and the start of the motor car era. There are also examples of engines and motor cars from distinguished names such as Armstrong Siddeley and Napier, whose companies became part of the Rolls-Royce group in their latter years.

The MMTA Member cost for this event including lunch and transport will be £70 (+ vat).

Places are strictly limited for this event. To book, click **HERE.**

## MMTA CONFERENCE ATTENDEES

(as at February 12th)

5N Plus
Aaron Ferer & Sons Co
ABS Alloys & Metals
Advanced Alloys Services Ltd
AIM – Indium Materials
Alex Stewart Assayers Inc
Alfred H Knight International Ltd
All Metals & Materials Inc
Amalgamated Metal Corporation
Ampere Alloys
Anglo American PLC
Anglo American Platinum
AON Commodity Trade Insurance
AREVA – Fuel Zirconium Sales
A&R Merchants Inc
Atlantic Metals & Alloys LLC
Aurubis AB
Avon Metals Ltd
Beijing Jiya Semicondutor Materials Co Ltd
Buss & Buss Spezialmetalle GmbH
Campine is
CMK Ltd – The Gallium Arsenide Company
Codelco USA Inc
C. Steinweg
C. Steinweg Belgium NV
Cronimet Central Africa AG
Darton Commodities Ltd
DK Associates
EAG
E&C Trading Ltd
EAC Corporation
Earth Metals LLC
Exotech Inc
Firth Rixson
F.W. Hempel Metallurgical GmbH
GE Aviation
Greenbriar Partners
Hard Assets Investor
Heraeus Metal Processing Limited
Hudson Metal Corporation
Hydrometal SA
Indium Corporation
Innova Recycling
Jean Goldschmidt International SA
Jiujiang Jinxin Non Ferrous Metals Co Ltd
Johnson Matthey Plc
Jurametal S.A.
Kazakhmys PLC
KBM Affilips BV
KGHM Group
KGHM Polska Miedz SA
Lambert Metals International Ltd
Lipmann Walton & Co Ltd

## PUBLIC PROCUREMENT OF MATERIALS CRITICAL TO US NATIONAL SECURITY

In the December "Letter from North America", Tom Butcher provided an overview of the potential acquisition of a range of materials by the Defense Logistics Agency-Strategic Materials (DLA-SM). Although many Members may be familiar with DLA-SM's acquisition and disposition procedures, this is just one part of an increasing focus by the U.S. Government — and the Department of Defense (DoD) in particular — on the procurement of materials critical to national security. In short, despite many years of reliance upon global supply chains to support government requirements, there is a growing effort among DoD leaders and defense prime contractors to actively manage their upstream supply, including supplies of raw materials such as minor metals, to ensure that systems are available on time and on budget.

Aside from the DLA-SM acquisitions mentioned above, the National Defense Authorization Act for Fiscal Year 2014 (Public Law 113-66) provided additional authority to DLA-SM to initiate programs to "provide for the recovery of any strategic and critical materials from excess materials made available for recovery purposes by other Federal agencies." In the past, even when DLA-SM could prove significant cost savings or benefits to the DoD or a military service, the absence of this small clause prevented DLA-SM from undertaking commonsense programs like recycling and stockpiling valuable strategic materials.

One immediate candidate is rhenium. Rhenium is among the most expensive metals due to its rarity, and it composes between 3% and 6% of some nickel-based superalloys in jet engines. The Tinker Air Force Base (AFB) Air Logistics Complex had operated a highly successful rhenium recycling pilot program from 2008 to 2011, with an estimated US$2 million (£1.22 million) in savings annually. However, because DLA-SM did not have the authority to take-over the program from the Air Force after the pilot phase, it was cancelled.

Another strong candidate, per the Annual Materials Plan (AMP) mentioned by Mr. Butcher, is yttrium oxide. Presently, nearly all of the world's primary production of yttrium occurs in China, but several companies have begun recycling yttrium oxide from compact fluorescent lighting (CFL). Existing DoD regulations already require the collection CFL, and if only 25% of DoD CFL were deliberately recycled for future stockpiling, up to 58 tonnes of yttrium oxide, 4 tonnes of europium oxide, and 3 tonnes of terbium oxide could be recovered. While not a total supply solution for DoD, this option might preclude the rather ironic purchase of Chinese yttrium oxide to mitigate a risk of Chinese export and production restrictions.

The latter material, yttrium oxide, is especially noteworthy because it typifies the shift in DoD thinking from a predominant reliance upon global supply chains to a more nuanced, hedging approach, as deemed appropriate.

Yttrium oxide often is analyzed as one of the "rare earth elements," in conjunction with the lanthanide series and, occasionally, scandium. For many years, the DoD has maintained that rare earth elements "are not uniquely important" to the DoD. The agency subsequently planned to pursue a multi-pronged approach that focused on long-term material substitution research, reclamation programs, diversification of supply driven by private markets, and — if necessary — the invocation of the Defense Priorities and Allocations Systems (DPAS). [The latter authority, found in Title 50 United States Code Appendix §2061 *et seq.*, provides the DoD with priority claim on U.S. supplies and foreign supplies that are imported into the United States.]

In no small measure, DoD relied upon market forces, not government intervention, to correct supply chain imbalance. Nevertheless, today DoD is starting to take note of the issues raised by the defense industrial base and espousing a more nuanced view, as noted in the most recent *Annual Industrial Capabilities Report*:

> The market for rare earth elements, though, is not homogeneous, as each element has its own distinct market fundamentals. Thus, there are individual rare earth materials and processing capabilities for which concerns remain regarding their availability, and for which the Department has taken action to address supply concerns. These include certain heavy rare earth elements and the ability to produce related high purity oxides, metals, alloys, and rare earth permanent magnets.

This nuance is part of a much larger "second look" at rare earth policy urged by the United States Congress and underway at the DoD. It is undertaking investigations into the extent to which its diversification of supply efforts are cost-effective and evaluating the impact of applying DPAS to the supply chains of the United States and its allies. A second investigation, using the Joint Strike Fighter as a case study, will consider whether material substitution of rare earths is cost-effective and technically-feasible, also taking into account indirect cost like engineering changes.

Each of these changes in policy points to more deliberate focus by DoD on the potentially vulnerable stages of the supply chain, colloquially known as "downstream weak links." This new focus fills a longstanding gap between mineral analyses, as typified by the U.S. Geological Survey, and high level industrial base studies, focusing more on upstream processing and manufacturing activity, largely related to the metals sector. This is a healthy evolution of industrial base policy, but arguably, this is even better for industry. Now, there is a considerably better chance to find an attentive audience with defense customers and policymakers to proactively manage upstream supply issues.

**Jeffery A Green, President, J. A. Green & Company**



## MMTA CONFERENCE ATTENDEES CONT'D

LS Nikko Copper Inc
Magnesium Elektron
Maritime House Ltd
Metalink International Co Ltd
Metal-Pages Ltd
Metherma KG
Meyer, Unkovic & Scott LLP
MMTA
Molymet
Natureo Finance
Pacific Materials (UK) Ltd
Pacorini Metals Rotterdam B.V.
Penningtons Manches LLP
Phoenix Infrared
Plansee SE
PM Recovery Inc
Portal Capital
Powmet Inc
RC-Inspection
Renault
Retorte GmbH
Rhecodor Special Metals
Rhenium Alloys Inc
Rio Tinto London Ltd
Rittenhouse International Resources LLC
Rolls Royce Plc
Roskill Information Services Ltd
S&A Alloys Inc
Sekom Handeles.m.b.H & Co Kg
Select Alloys & Materials Ltd
Shaanxi Huadian Fine Chemical Co Ltd
Siegfried Jacob Metallwerke GmbH & Co KG
Sims F E Mottram Ltd
SMR
Sovereign Int'l Metals & Alloys Inc
Stapleford Minerals & Metals
Strategic Metal Investments Ltd
Tasman Metals Ltd
Terra Commodities
The Chem-Met Company
The Fanya Metal Exchange
Todini & Co SPA
TRADIUM GmbH
Tranzact Inc
Traxys Europe
Traxys North America
Tropag
Umicore Precious Metals Refining
Vital Materials Co Limited
Voyager Group
Wogen Resources Ltd
Womet GmbH

## MMTA AGM

The MMTA's AGM 2014 will take place during the conference at 15.15 on Monday 28th April 2014.

Venue: Victoria Park Plaza Hotel, London, UK

All Members are encouraged to attend.

The Notice of AGM and Agenda will be circulated to all Members in due course.

The AGM offers an ideal opportunity to hear about the ongoing work and projects of the MMTA.

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# MAGNESIUM METAL MARKET OVERVIEW

## About Magnesium

Magnesium was first found in an area of Thessaly, Greece called Magnesia. It is the third most abundant metallic element in the earth's crust, however it is rarely found in its pure form due to the fact that it bonds with other elements easily. Magnesium metal was first produced from ore in 1808 in small quantities by Sir Humphrey Davy, and industrial production first began in 1886 in Germany.

## Magnesium Facts

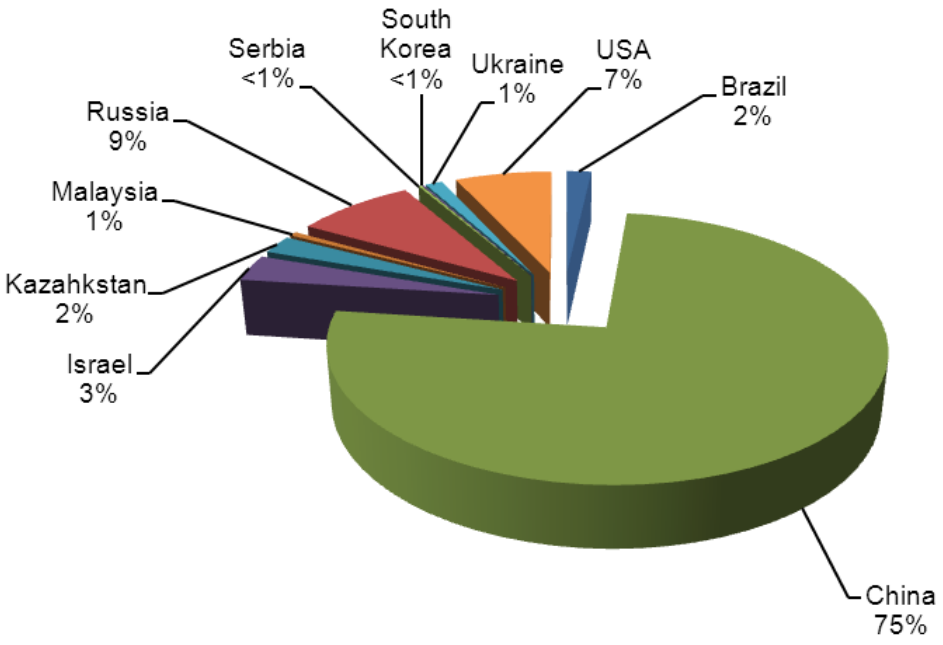
Magnesium is the lightest of all commonly used structural materials with a density of 1.7g/cm$^3$ (106.13lb/ft$^3$), approximately one-third that of aluminium and titanium, and one-quarter that of steel. Despite this advantage, output of primary magnesium in 2012 at 905kt was only 2.5% of primary aluminium output (45.2Mt) and 0.06% of crude steel output (1,546Mt). Magnesium output did, however, exceed that of titanium (211kt).

Small additions of magnesium to aluminium impart heat treatability and strength. Magnesium's affinity with sulphur makes it indispensable in the production of certain grades of crude steel. It also reduces titanium tetrachloride to titanium metal in the Kroll process, and nodularises iron to produce very high cast iron grades. Together these four applications accounted for 61% of magnesium use in 2012. Thus despite its relative minnow status in structural materials output, magnesium plays a central part in the manufacture and use of competing metal products.

## Magnesium Supply

World production of primary magnesium is estimated by Roskill to have increased from 499kt in 2002 to 905kt in 2012, a compound annual growth rate (CAGR) of 6.1%. Production of primary magnesium metal is confined to ten countries. China dominates the industry, with output of 680kt in 2012 (75% of the global total) up from 200kt in 2001.

**World: Primary production of magnesium by country, 2012**




*Source: "Magnesium Metal: Global Industry Markets & Outlook 2012", Roskill Information Services Ltd.*

Despite recent efforts by the Chinese government to consolidate the industry, most Chinese production capacity is still spread across relatively small plants, with consolidation mainly occurring at a corporate level. Eight Chinese companies are in the top-10 of world suppliers by capacity, each exceeding

50ktpy, although in 2011 only five produced more than 30kt and one closed in 2012. The number of companies with a capacity below 50ktpy, and producing much less than 30ktpy, is unknown but Roskill understands they total around 50. Combined, these smaller plants accounted for around a third of global capacity in 2012.

The main primary magnesium producers outside China are VSMPO-Avisma and Solikamsk Magnesium Works in Russia; US Magnesium in the USA; Dead Sea Magnesium in Israel; Ust-Kamenogorsk Titanium and Magnesium Plant in Kazakhstan; Rima Industrial in Brazil; CVM Minerals in Malaysia; Magnohrom in Serbia; and, POSCO in South Korea.

Secondary magnesium from recycled magnesium alloys, and as a constituent of recycled aluminium alloys, is an important source of supply, particularly in the USA, where it accounts for about half of the total. It is of much less importance elsewhere. Global capacity and production of secondary magnesium (excluding aluminium alloys which form a closed-loop cycle) is estimated at over 200ktpy by Roskill, about 40% of which is centered in the USA.

### Magnesium Trade

The bulk of international trade in magnesium is dominated by exports from China, which accounted for half of <99.8% Mg unwrought magnesium exports and two thirds of >99.8% Mg unwrought magnesium exports in 2012. This material is largely imported by Canada, Japan and Europe. The US market is protected from Chinese imports by high antidumping duties and is supplied instead by Israel and domestic primary and secondary production. According to data from Global Trade Atlas analysed by Roskill, international trade in unwrought magnesium fell from roughly 500kt in 2007 to 305kt in 2009. It rebounded to 480kt in 2011 but fell slightly in 2012.

About 50kt of waste and scrap was traded in 2012 (down from 62kt in 2007), largely comprising exports from Canada, Germany and Austria, and imports into the USA, Czech Republic and Hungary. In addition, around 110kt of raspings, turnings, granules and powders were traded in 2012, mainly exports from China and imports into Germany, Turkey and Canada. Finally, 37kt of wrought articles were traded in 2012 (down from 46kt in 2011), consisting mostly of exports from China, Austria and Germany, and imports into Taiwan, New Zealand and the UK.

### Magnesium Demand

Global apparent consumption (production + imports – exports) of magnesium reached 1,050kt in 2007, a CAGR of 8% from the 630kt consumed in 2001, before falling by 11% in 2008 and by 15% in 2009, to 840kt, as the global economic downturn significantly decreased demand for magnesium containing products. Apparent consumption rebounded through to 2012 to reach what Roskill estimates as a new peak in use of just under 1.1Mt.

China dominates world consumption at 340kt in 2012, 33% of the global total. Other major markets for magnesium include North America (23% of global consumption) and Europe (18%). Russia and Japan are also large consumers, together accounting for 12%.

Historically, aluminium alloys have been the primary use for magnesium worldwide, although in 2012 this end-use was tied with magnesium die-casting alloys, each accounting for around 365kt, or 33%, of total consumption. The packaging industry is the largest market for magnesium in aluminium alloys, followed by transport, construction and consumer durables.

The automotive industry is by far the largest user of magnesium die-cast components. Die-cast magnesium alloy is used for housings, assemblies, brackets and other components for all sections of motor vehicles; the average use of magnesium per vehicle in 2012 was 2.3kg, but was as high as 26kg for some models. Magnesium die-cast housings for communication devices (such as cell/mobile and smart phones), laptops, tablet and notebook computers, and other electronic equipment is the next largest use after automobiles.

## DIARY DATES

**Import Training Course**

13th -14th March,
MMTA Office, London

**Informal Drinks & Dinner**

13th March 2014

The Bank Westminster, London

**MMTA's International Minor Metals Conference**

27th -29th April 2014

Victoria Park Plaza, London

**Rolls-Royce Visit**

30th April 2014

London/Derby

**41st Anniversary Dinner**

21st October 2014

Intercontinental Hotel, London

**New York Dinner**

December, New York

**Christmas Lunch**

17th December 2014

Ironmongers' Hall, London

## ISTA IMPORT TRAINING COURSE

The MMTA will again be hosting the successful Import Training Course in partnership with ISTA.

**Date: 13th-14th March 2014**

**Venue: MMTA Office**

**Cost: £395 (+vat) for MMTA Members**

Course Content: Operational Issues for International Traders & Importers, including:

The Import Chain

The new Incoterms 2010 (and comparison with Incoterms 2000)

Customs Formalities

VAT/Duty

Methods of Shipment

Cargo Insurance

Documentation

Methods of Payment (1) – brief of each method; selection of payment methods; negotiation of payment method

Methods of Payment (2) payment in advance; open account; bank collections; bills of exchange

Methods of Payment (3) Letters of Credit: how they work; procedures; types

Opening an L/C; Responsibilities; International Standard Banking Practice

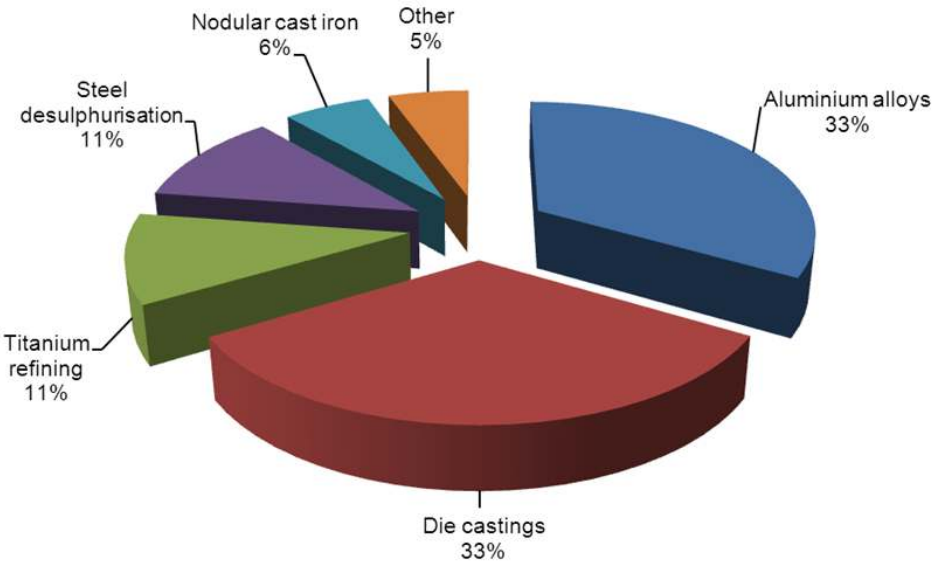
Discrepant documents; disputes; topical issues

Contingency insurance cover

To book, click **HERE**.

# MAGNESIUM METAL MARKET OVERVIEW CONT'D....

**World: Consumption of magnesium by end-use, 2012**




*Source: "Magnesium Metal: Global Industry Markets & Outlook 2012", Roskill Information Services Ltd.*

Titanium sponge (i.e. crude titanium metal) was the third largest use of magnesium, accounting for about 123kt, or 11% of total global consumption in 2012, and desulphurising of steel the fourth largest use, accounting for 119kt in 2012. The use of magnesium in steel manufacture has slowed in recent years, due to the global economic downturn and resultant slowdowns (or declines) in steel output in many countries. On average, magnesium is used globally at a rate of about 50g/t steel.

Magnesium is also used in other applications, such as the nodularisation of cast iron and cathodic protection, a method of preventing corrosion by forcing all surfaces of a metal structure to be cathodes through the provision of external anodes of active metals. Roskill estimates that magnesium use for these two applications was in the order of 65kt and 60kt in 2012.

## Magnesium Prices

There is no terminally traded market for magnesium and therefore the majority of business comprises contracts negotiated between producers and consumers. Nevertheless, a large volume of Chinese material is sold on spot basis by traders and Chinese producers into the European, Japanese and domestic markets. Key magnesium spot prices, therefore, are the Chinese domestic and export prices for 99.8% Mg metal, and the European price ex-Rotterdam warehouse. Some magnesium is traded outside of China from other countries, but this forms a smaller part of the overall open market.

Rising demand, particularly inside China, resulted in rapid price increases in the fourth quarter of 2007 and the first half of 2008. At their peak in the first half of 2008, prices had soared above US$6,000/t FOB China for magnesium 99.8% ingot. Prices have since retreated to lower levels, though still higher than the pre-2007/08 peak, driven lower by diminished demand due to the global economic downturn. The cessation of China's 10% export tax at the end of 2012 has had a ripple effect on both European prices and Chinese prices for export, with 2013 prices between US$2,500-3,000/t FOB China. Because of antidumping tariffs on Chinese material, magnesium sells at a premium in the US.

**Provided by: Roskill Information Services, November 2013**

Roskill
Approachable. Independent. Expert.

## RARE EARTH ELEMENTS: SUSTAINABLE EUROPEAN RESOURCE?

***China produces well over 90% of the world's REE supply but only has around 37% of known reserves.***

This edition's Critical Raw Material subject is focused on Rare Earth Elements (REEs), and whether we are on a path to a sustainable and reliable European supply after the 2011 supply shock and subsequent exploration investment frenzy. Triggered by severely reduced Chinese export quotas and a sudden media awareness of the dependence of many new technologies on REEs unique properties, REEs came under the spotlight in the mainstream media.

Here we will look at the recent unstable story of REEs and how the challenges of providing diversified sources of raw material are being resolved. REEs, according to CRM innovation network, are not prime candidates for substitution. In many of their applications REEs are only substitutable at high cost and loss of performance. One of the properties of some REEs includes the formation of extremely strong magnets, meaning they are essential for computing, communication, medical, transport, clean energy and defence applications. Very few metals can form magnets, meaning the option to substitute REEs for lower cost material does not exist.

In August 2010, China cut export quotas of REEs by 40% resulting in a price spike by 10-20 times, as well as a large price difference between Chinese domestically consumed material and Chinese export material. Stockpiling began in some countries, attempts to reduce consumption were investigated, the research into using REEs in new applications was delayed and we saw the large scale shift of western manufacturers to China to secure raw material supply and lower their costs.

These events highlighted the risks of limited production sources and reliance on 'market-based' supply strategies. Before this price hike, European REE mining was not considered or researched, as REEs were consistently available at an accessible price from Chinese suppliers. A lot of learning was required to place Europe at the forefront of REE supply.

Research projects were launched by large industrial companies into how these materials were used and their future supply trends. This interest led to hundreds of exploration projects being identified with the aim of finding new Western resources to insulate industry against future Chinese price fluctuations. In 2012 REE prices fell back to a more reasonable level, leaving little time for these explorations to bear fruit.

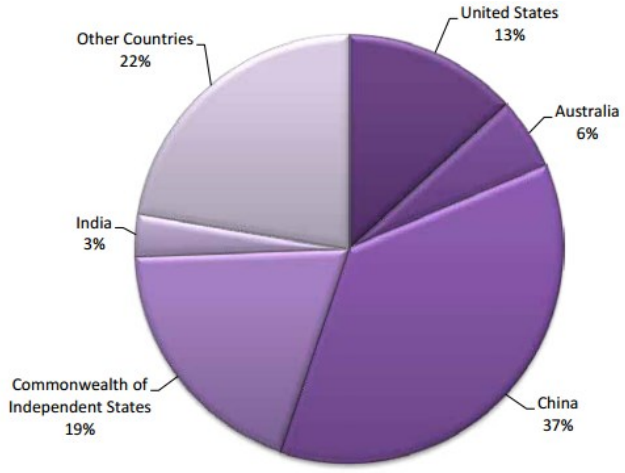



*Figure 1:*

*Global Distribution of REE reserves, (Hedrick 2010), (The British Geological Survey Commodity Profiles 2010)*

http://nora.nerc.ac.uk/12583/1/Rare_Earth_Elements_profile.pdf

### INFORMAL DRINKS AND DINNER

Whether you are attending the Import Training Course or not, come and join fellow MMTA members and guests for informal drinks followed by dinner.

**Date: Thursday 13th March**

**Venue: The Bank Westminster**

**Cost: for MMTA Members is £50 (+ vat) incl wine**

**Time: Drinks from 17.30 Dinner 19.00 for 19.30**

Situated in the heart of St James, this charming venue has a fantastic bar, great food and a lovely private dining room, where the dinner will be held. The date is perfectly timed for those who are taking the Import Training Course, but can be booked separately to the course.

The informal drinks will be a cash bar and are an excellent opportunity to join us after work, even if you are not able to stay for dinner. Guests are welcome.

To book, click **HERE**.

## FICTIONAL ALLOYS

As a Sci-Fi, super hero and materials fan, fictional alloys and their properties are often not only the key to the character's powers, but may also offer clues to where future alloy developments could be heading!

Below is a selection of our favourites:

**Adamantium** - Wolverine's skeleton in the X-Men series – described as a nearly indestructible alloy made of iron mixed with chemical resins.

**Unobtanium** - is a mineral and a room-temperature super-conductor for energy. In the film Avatar, it is mined on Pandora and has an Earth value of $40 million per kilogram when refined.

**Bolonium** - an element that can be used for everything and nothing, often referred to in Futurama and The Simpsons.

**Mithril** – a durable silvery metal mined in Moria in Middle Earth that is extremely light and strong. It also has the ability to capture moonlight.

**Vibranium** - A rare, naturally occurring metallic substance theorized to be of extra-terrestrial origin. The material was used to construct Captain America's shield and is also cited as one of the additives in Adamantium.

If any Members are currently trading in these materials, please contact the executive team.

## RARE EARTH ELEMENTS: SUSTAINABLE EUROPEAN RESOURCE? CONT'D...

Consumers and investors felt less pressured to find new sources of material with the drive for substitution, reduction and recycling also waning. (REEs remain prominent on criticality lists by governments as seen in previous editions).

At the end of this period of turmoil less than 10 exploration projects globally are still in the pipe line. These have risen above their peers, are professionally managed, quality projects with real chances to go into production. If these projects succeed they will provide more raw material than the western market requires, but China has shown interest in securing alternative supply options and have bought into a number of Western REE companies. The challenges for the remaining projects are in supply chain development rather than the finding of suitable material to be mined.

The EU is actively supporting policy to promote the domestic supply of strategic metals to secure high-tech industry. Here we will look at the case of REE mining in Sweden and the company which has undertaken the challenge, Tasman Metals Ltd.

*Tasman Metals Ltd is a European focussed strategic metals company, which holds a portfolio of exploration projects with potential for rare earth elements ("REE"), zirconium, hafnium, and niobium.'*

In conversation with Jim Powell, Vice President - Corporate Development at Tasman Metals.

### Why was Tasman Metals able to keep going when the vast majority of the other new REE projects failed?

At the peak of the market, there was a substantial pool of financing available for REE exploration projects. As prices retreated, however, the REE exploration industry was subject to additional scrutiny, with many projects deemed too remote, too early stage or in unfavourable jurisdictions and therefore investors and end consumers understandably lost interest. Tasman's Norra Karr project is more strongly weighted towards the higher value, heavy rare earth production and has extensive existing infrastructure, which means economic viability has remained after the prices fell.

### What are the key barriers for entering the REE market and how will they be overcome?

The main barrier has to do with supply chain complexity. Developing a supply chain outside China is a challenge and at present there are few options. An integrated robust supply chain with western REE separators, metal makers and magnet manufactures needs to be created to guarantee supply. The quality of the product from Tasman (extracted from the mineral eudialyte) and the presence of existing supply-chain participants in Europe will help to ensure Tasman's success in this regard.

### When will Tasman be ready to sell their material?

At the moment we are in a detailed feasibility phase with the earliest projected date for producing material late 2016.

As mentioned, before 2011 it wasn't economically viable to consider European mining. Has the legislative side proven to be a large hurdle in terms of Environmental standards required?

As a Canadian company operating in Sweden, Tasman is used to working to strict EHS requirements under scrutiny and ensuring we have a low environmental impact. Tasman's Norra Karr project is unique in that radioactive metal content is extremely low and thus not an issue requiring additional legislation. Ultimately, creating a sustainable, traceable and reliable supply of REEs is our aim. In general operating in Sweden is not significantly different to operating in Australia or Canada.

Based on some literature sources there is little information on the availability of REEs and other minor metals in Scandinavia, is making people aware of information a key challenge for Tasman?

Sweden has a long history of working with REEs as many of the elements were discovered there historically. Tasman's Norra Karr project is a relatively new discovery made by the company in 2009, and so was not previously reported in databases of the US Geological Survey or British Geological Survey. As a result, we have had to work hard to ensure consumers and investors know that the project is now the 4th largest heavy REE project in the world. Supplying sustainable and ethically sourced REEs to Europe is possible from Tasman's Swedish projects for at least 40 years, allowing supply risk for REEs to be a thing of the past.

And in Conclusion....

These developments in Europe, as well as other viable projects in the USA and elsewhere, will hopefully provide more secure and predictable supplies for the different regions. Demand for REEs will continue to grow and establishing alternative sustainable sources for supply is important to ensure that innovation is not hindered by unreliable resources. Scandinavian mining of REE provides high quality products with political and economic stability. The development of new sources of REEs takes many years of sustained investment, and despite the relative stability of the current price, industry is seeking more environmentally sustainable and secure supplies.

***Tasman Metals Ltd** is a Canadian mineral exploration and development company focused on Strategic Metals in the European region. Tasman was formed in October 2009, from the amalgamation of private Canadian company Tasman Metals Ltd and two capital pool companies Ausex Capital Corp and and Lumex Capital Corp. The public entity began trading on the Toronto Venture Exchange (TSX.V) on 3rd November, 2009 under the symbol "TSM".*

**THERE IS STILL TIME TO COMPLETE OUR TRADE CREDIT AND MARINE INSURANCE SURVEY.**

**CLICK HERE**

We will be publishing our findings in the next edition of the Crucible and the Insurance Task Force will be using the responses we receive to set up meetings with relevant brokers and underwriters on behalf of the MMTA Membership.

Many thanks to those who have already responded.

## THE GOLDEN AGE OF POISON

The Victorian era (1837-1901) was considered a 'Golden Age' for poisoning, and arsenic was a favourite among poisoners. Why? There were several key reasons:

Arsenic was literally everywhere and would not have raised the slightest suspicion when purchased over the counter. Arsenic was used in the colours in flooring, wallpaper, furnishings and even children's toys: 3 different arsenic compounds created yellow, red and green pigments. Medically, it was used as a general tonic, one of the earliest treatments for syphilis, and as a treatment for arthritis, tuberculosis, diabetes, malaria, with varying degrees of success. Arsenic compounds were used in insecticides, rat poisons, herbicides and wood preservatives, as well as cosmetics. By the mid 1800's, however, although it was still in widespread use, for medicinal as well as domestic purposes, Drs were beginning to have doubts about its safety.

Arsenic had many advantages for the murderer: the crime could be committed secretly - arsenic trioxide being colourless, soluble in liquid and almost tasteless in food or drink - and quietly, leaving no evidence until the development of a test to identify it in the body in the 1830s. Even once tests were developed, juries were reluctant to convict on forensic evidence alone, often considering it as circumstantial because they did not understand it.

It may be a coincidence, but this period also coincided with the introduction of a new financial product, namely life assurance. Some believe that poisoning was a common defence against domestic abuse, and during the Victorian period, although 40 women were tried for poisoning their husbands, this figure is believed to be only a small percentage of the real figure.

## THE TRANSATLANTIC TRADE & INVESTMENT PARTNERSHIP (TTIP) — IS IT THE RIGHT DEAL FOR GLOBAL TRADE?

The TTIP is not just a classic free trade agreement; the EU and US economies are deeply interdependent and the agreement, if successful, will not only be important for the GDP of both parties, but will be the 1st step towards creating a template for future agreements with emerging markets.

The MMTA recently attended a meeting with representatives of the European Commission and Parliament, as well as lead members of the negotiating teams. They are adamant that if they didn't think it could be done, they wouldn't have started the process, and if successful, the TTIP will not only streamline and remove barriers to EU-US markets, but will also allow both to compete more favourably on world markets. The agreement aims to create jobs and growth, as well as drive down prices.

The terms of this agreement will surely impact not only the two trade entities concerned, but will also have a direct or indirect impact on other countries.

Read a full report of the conference in the Members' Area.

## BOOK REVIEW—CRITICAL METALS HANDBOOK

Mankind is using a greater variety of metals in greater quantities than ever before. As a result there is increasing global concern over the long-term availability of secure and adequate supplies of the metals needed by society. Critical metals, which are those of growing economic importance that might be susceptible to future scarcity, are a particular worry. For many of these we have little information on how they are concentrated in the Earth's crust, how to extract them from their ores and how to use, recycle and dispose of them effectively and safely.

This book brings together a wealth of knowledge on critical metals and thus provides a foundation for improving the future security and sustainability of critical metal supplies. Written by international experts, it provides a unique source of authoritative information on diverse aspects of the critical metals, including geology, deposits, processing, applications, recycling, environmental issues and markets. It is aimed at a broad non-specialist audience, including professionals and academics working in the exploration and mining sectors, in mining finance and investment, in mineral processing and manufacturing. It will also be a valuable reference for policy makers concerned with resource management, land-use planning, eco-efficiency, recycling and related fields.

The CMH will not be used by professionals to learn more about their own field, but rather to provide them with key information from the other disciplines. For example, an expert on deposits of cobalt may not find a great deal new about this in the CMH, but, hopefully, he or she will find out more about other parts of the cobalt life cycle or about other commodities such as, for example, rare earths or gallium.

The CMH provides a unique, one-stop source of information on diverse aspects of the critical metals and is written in 3 introductory chapters, followed by 13 commodity-specific chapters written in a readily accessible style using a common template.

I also wanted to clarify the current meaning of the term 'critical' and the related implications for the security of supply of mineral commodities. There is no single, correct or fixed list of 'critical metals' but we do need an 'early warning system' to flag up those for which there is a possibility of supply disruption. Having done that, we can begin to think about mitigation of the supply risks for each. Chapter 1 of the CMH introduces the concept of criticality and sets the scene for the rest of the book.

I have attended numerous meetings on critical/strategic minerals in recent years and many/most of these have identified high-level generic solutions for resource security based essentially on the diversification of the supply base, substitution, recycling and improved resource efficiency. While such approaches are, indeed, generally potentially very useful, I am convinced that, given that the life cycle of each commodity (from exploration and mining through to manufacture, recycling and disposal) is unique, each commodity requires separate individual analysis and the development of tailored solutions. One size does not fit all!

The commodity-specific chapters in the CMH aim to provide essential background for individual critical metals which can better inform the development of supply risk mitigation and related policy and research.

**A G Gunn, British Geological Survey**

**Editor, Critical Metals Handbook**

## ANNUAL REVIEW 2014

We will shortly be contacting MMTA Member companies to verify their contact details are correct for entry into the Annual Review Members' Directory.

Please take 2 minutes to review this information and confirm or amend.

Thank you for your assistance.

## LETTER FROM NORTH AMERICA

Dear Members

A belated Happy New Year! And may 2014 be both prosperous and happy for you all.

As many of you may have seen, it has been a wee bit chilly here recently. And we've also had a smattering of snow. In fact, to-day, as I look out of my window, it is snowing so hard I can see few of the nearby buildings very clearly: hey ho! Yes, the snow may be an inconvenience, but it does mean that, when it melts, our reservoirs get fuller. And that's no bad thing. We can always do with the water.

Taking a somewhat similar view, but with a different riff on it - we can always do with minor metals - recent research here in the U.S. has come up with some interesting findings. Two sets of research deal with the potential use of what we would most usually term industrial waste as a resource for various minor metals and, in particular, rare earths.

Back in July last year, the U.S. Geological Survey (USGS) published a short piece entitled **Mine Tailings and Forgotten Rocks Key to New Technology?**, from which we learned that it is "*reanalyzing rocks, minerals and associated mine tailing samples – some collected 120 years ago – to assess their rare and critical elements, which could become potential for economic development*".

As can be imagined, the popular press had a field day, with the wildest stories of riches to be made, and even the possibility of a new gold rush. However it didn't take long for the more sober press, and various experts, to scotch such notions. But the concept still remains an interesting one.

Whilst the presence of rare earths in coal ash may be no new story (as long ago as September 1935, V.M. Goldschmidt of the Mineralogical Institute at the University of Göttingen in Germany, published a paper entitled **Rare elements in coal ashes**), recent research from sources as disparate as the University of Kentucky, an environmental and risk science consulting firm, and a company providing contract research and development services (both here in Massachusetts) has addressed anew the fact that not only the rare earths, but also the likes of gallium, germanium, indium and tellurium can often be found in fly ash.

Perhaps understandably, the various papers and presentations dealing with the subject did not receive as wide (or wild) coverage as the USGS story. But it is nevertheless an interesting idea, not least because there is so much fly ash just sitting around doing nothing. (Or, as many environmentalists think, not nothing, but things that are actually not very nice, like polluting water supplies.)

In both instances, I think what's encouraging is that people are looking around at what's out there and thinking: "Hmm, I wonder if there's anything in that pile of …. that may be valuable and wasn't the reason it was dug up/produced/by-produced in the first place. I think I'll have a look…"

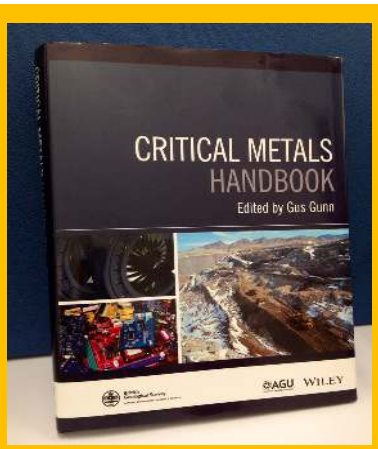
Will anything be extracted from either the fly ash or the tailings any time soon? Who knows? But if the likes of Tsumeb in Namibia are anything to go by, then we'll probably have a long wait ahead of us.

Finally, fellow members, a quick plug for the **Critical Metals Handbook**, edited by Gus Gunn of the British Geological Survey and just published by Wiley. Fellow member Anthony Lipmann (rhenium), and I (gallium), both had the honour of contributing to it. And, I have to say, it really is a good read.

See you, I hope, at the MMTA conference in London in April. And, from a wintery NY, my best wishes, as always.

**Tom Butcher**

**Hard Assets Investor**




**MMTA MEMBER OFFER**

20% discount for MMTA members on the price of both the book and e-book editions of the Critical Metals Handbook, published in February 2014 by Wiley.

For more information and the Member purchase code, please log in to the **Members' Area** of the MMTA website.

To view the book, or for non-member orders, click **HERE.**

## REPORT FROM THE COMMODITIES ASSOCIATIONS DIALOGUE MEETING IN LONDON

The MMTA recently attended the 2-day Commodities Associations Dialogue meeting hosted by Rio Tinto in London.

The aim of the meeting was for a wide range of metals related commodity associations to discuss issues common to all metals, and all metals' associations, to determine which issues allow the metals industry to speak with one voice, and to establish an early warning system for potential threats coming down the pipeline, particularly on the regulatory front.

We discussed:

- Ongoing REACH-related issues

- Changes in the systems for hazard classification, as well as lack of harmonisation which creates challenges for particular metals attempting to gain agreement on which data is correct for the purposes of hazard classification

- The development of green building standards coming out of the building and architectural sectors, where materials life cycle impact assessments will have increasing relevance for the metals sector.

We will be reporting on developments in these areas over the coming months.

## THE NEW AGE OF ROBOTS: THE FUTURE IS COMING

Recent news has been awash with reports about Robots; could this industry become the next big growth area for minor metals? For decades we have been hearing how robots will make our lives easier, taking on unpleasant household chores and enriching our lives by increasing our leisure time. Until now, the necessary robot innovation has failed to materialise and has remained alive only in Sci-Fi films and futurist fantasies.

Recent developments suggest, however, that perhaps the robot is finally coming of age, and alongside it, there is a growing demand for minor metals. Investment in robotic technologies has been massive over the past few years, with Google recently purchasing Boston Dynamics, a US military contractor specialising in animal robots, this being the eight robotics company bought by Google this year. Boston Dynamics is famous for creating the world's fastest robot and others that can successfully navigate over rubble and inhospitable environments. The price Google paid for this company is unknown.

In addition to great mechanics and physiological advances, artificial intelligence research is on the rise, too. Again Google has acquired the London start-up DeepMind for a reported £400 million, which is developing sophisticated 'machine learning' technology, through which computers will be able to teach themselves new skills without the need for humans. It is not known what the aim of Google's secretive robotics arm is, but they are not the only prominent company pushing the development of this technology.

The manufacturing industry has already been taken over by robots performing the mindless and repetitive tasks which once gave employment to thousands of assembly line workers, and anyone visiting an automotive production line is likely to be impressed by their speed and precision, but with the new generation of mobile and intelligent robots, it is interesting to speculate what other jobs may become obsolete. Sir James Dyson has just announced that he is working toward creating an affordable household android able to carry out menial chores, and will be investing £5 million to achieve this vision.

He stated that the robots Dyson will create are a "*new generation of robot that understands the world around them" and "will be able to clean the house, put out the bins and even keep an eye out for intruders".*

Not very good news for some jobs, but Robot engineering, design, programming and related functions will grow massively if the aim is to have a 'robot in every home'. Access to raw materials to create these machines is a key consideration; the new generation of robots are mobile computers and so heavy users of minor metals - a further pressure on sometimes limited resources. LCD screens, LEDs, sensors and special alloys are all minor metal intensive components often appearing in new models.

At the moment, it seems that we are still a few years away from truly 'useful' robots that will impact our day to day lives. Events such as the Robot Olympics and Robot football World Cup clearly show that research and investment in these technologies is strong and growing.

A recent visitor to the MMTA office was Nao, a humanoid robot made by Aldebaran, a French robotics company, and standard platform of the Robot World Cup (RoboCup). He is autonomous and programmable and is used in research institutions around the world, as well as playing football very well. Some of Nao's features include HD cameras, anti-collision sensors, 14 LEDs, circuit boards and voice recognition capability.

Research has shown an interest in using these robots as lab assistants, and a Japanese university is currently training a team of Nao robots to perform this function. Nao also has an interesting effect on children, being child-sized himself. Children seem to trust Nao and see him as a confidante. This potentially opens up further careers in the field of forensic interviewing, as children may be less distrustful of Nao than of an adult. Studies have also shown that autistic children can relate and communicate with Nao.

Looking at the specific anatomy of Nao, minor metals are abundant. After a brief examination of his data sheet and of the technical components inside him, I was able to identify: tantalum oxide, arsenic, gallium, indium and REEs, as the most obvious minor metals without the need for a full robot autopsy!

Based on these new advances, over the next few years the new robotics age will prove to be a real growth area, with minor metals playing a crucial role in its success.

**Tamara Alliot, MMTA**

**See the video of Nao talking about Minor Metals**

## NEW MMTA PROFESSIONAL PARTNERSHIPS

The MMTA has recently become members of IOM3, the Institute of Materials, Minerals & Mining, and ASM International, the US-based materials science and engineering society. Both of these organisations offer information, professional development opportunities and research materials. We will be working with IOM3 and ASM to bring benefits to MMTA Members.

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