

# Strategic Metals & Rare Earths Letter

## INTERNATIONAL

*the independent information and advisory publication on investing in Strategic Metals & Rare Earth*

**July 2018**

### Magnesium lightest of all light metal alloys

Magnesium is found in seawater and brines, as well as in deposits in the earth. There are three different types of magnesium ore: magnesite, dolomite and carnallite.

Traces of magnesium can be found in mineral waters. The element is a part of green plant chlorophyll.



**Magnesium** is the lightest of all light metal alloys and therefore is an excellent choice for engineering applications when weight is a critical design element. It is strong, has good dissipation, good damping and is readily available. Its properties make it easy to weld, cast or machine. It can be alloyed with other metals, making them more beneficial.

The use of pure magnesium is rare due to its volatility at high temperatures and it is extremely corrosive in wet environments. Therefore the use of magnesium alloys when designing aerospace and automotive parts is critical.

Burning magnesium produces white light. This makes it ideal for firework sparklers, flares and flash photography. It also functions as an agent to produce uranium out of salt. The element's ions are necessary for every living organism. That is why magnesium salt is included in fertilizers and food.

In many cases, Magnesium bromide is utilised as a sedative. Magnesium is also used to remove sulphur from iron and steel.

### Magnesium has numerous components

The most vital commercially are sulphates, carbonates, chlorides and oxides

These are used in textile processing, leather tanning, insulation, fertilizers, cosmetics and ceramics.



The citrate of magnesia and magnesium hydroxide are used in medication. Health problems related to lack of manganese intake can be avoided by increasing magnesium intake.

**Magnesium alloys** are in use around the world in a variety of different applications. These are a preferred material when looking for weight reduction without compromising overall strength. The vibration damping capacity is also beneficial in applications in which the internal focus of high-speed components must be reduced.

The most common applications are: Aircraft and missile components; aircraft engine mounts, control hinges, fuel tanks, wings; automotive wheels, housings, transmission cases, engine blocks; bicycles and other sporting equipment; equipment for material handling; ladders; laptops; television; cell phones; luggage; portable power tools; chain-saws, hedge clippers, weed whackers; printing and textile machinery; steering wheels and columns, seat frames.

Magnesium alloys have also been used as a replacement for some engineering plastics due to their higher stiffness, high recycling capabilities and lower cost of production.

## ► **China** dominates world magnesium supply

**China** has topped world magnesium production for two decades, accounting for 70% of world magnesium capacity. With world 2017 primary magnesium production estimated by US Geological Survey at 1.1 million tonnes, **China** is accounting for 930,000 tonnes or 85% of total recorded, production followed by Russia (60,000 tonnes), **Brazil** (16,000 tonnes), **Turkey** (15,000 tonnes), **Kazakhstan** (10,000 tonnes) and **North Ko-rea** (10,000 tonnes).

In 2017, according to **USGS**, US product shipments were 330,000 tonnes, imports for consumption 400,000 tonnes and exports 110,000 tonnes. For strategic reasons US primary production is not released since 2017. Production in China is focused on **Liaoning Province**, with its main magnesium production region split between two hubs: **Dashiqiao** in Yingzhou and **Haicheng** in Anshan.

**Shanxi Yinguang Magnesium Industry (Group) Co.** is the largest primary magnesium producer in China, with a primary magnesium capacity of approximately 100 kilotons. Its major subsidiary Shanxi Yinguang Huasheng Magnesium Industry ranks number 1 in China in terms of primary magnesium output. The Company has formed a complete industrial chain covering every stage from magnesium ore exploration to magnesium alloy deep processing.

A new 100,000-ton-per-year plant in **Qinghai Province** that would produce magnesium from lake brines was completed in 2017 end was expected to range up to full capacity in early 2018.

Some plants producing magnesium using Pidgeon (silicon thermic reduction process) were expected to shut down, owing to energy cost increases and to comply with regulations ordered by the Government of China.

**World magnesium reserves are estimated at 7,800 million tonnes**, which are highly concentrated in three countries: Russia 2,300 million tonnes, North Korea 1,500 million tonnes and **China** 1,000 million tonnes.

## ► **China's** largest magnesium alloy producers

**Nanjing Yunhai Special Metals** is the largest producer of magnesium alloys in China, with a capacity of approximately 140 kiloton. The company is accelerating its magnesium alloy capacity expansion and developing the upstream industrial chain in the region with rich magnesium ore resources such as Shaanxi Province.

**Dongguan Eontec** is a major manufacturer of magnesium alloy precision die castings in China. The company, which went public on the GEM of the Shenzhen Stock Exchange in 2012, has maintained rapid revenue growth from magnesium alloy products in the last few years. The company accelerated the strategic switch to 3 C products, and the magnesium alloy shells and internal brackets for tablets, PCs and smart phones will be the main business growth points for the company in the future.

## ► **Key differences - Magnesium versus Manganese**



**Magnesium (Mg)** and **Manganese (Mn)** have similar sounding names, they are both metallic elements in the periodic table and are both essential nutrients needed by the human body.

The key difference between magnesium and manganese is that magnesium is an alkaline earth metal in s-block, whereas manganese is a transition metal in the d-block of the periodic table.



Both magnesium and manganese have similar uses, but their function and properties are different. For example both are used in alloys, but their properties and applications are not similar

## ► Magnesium pricing

President Xi's focus on pollution control, as well as economic growth has implications for the global supply chain in magnesium components, as well as many other industrial raw materials. Magnesium prices in **China** in Q2 2017 tripled over those seen in Q1 2017 and stayed at US\$ 630-740/t for 97.5% MgO, lumb DBM, FOB China into the Chinese new year in February 2018.

Magnesium compounds outside China reported improved financial results, supported by trends in refractory markets, as well as the impact of China's 5-year environmental objectives. Brazil and the European Commission approved the acquisition of Brazilian refractory maker Magnesira Refractorios by Austria's RHI.

### Magnesium & Magnesium-Ion Batteries – Key Points

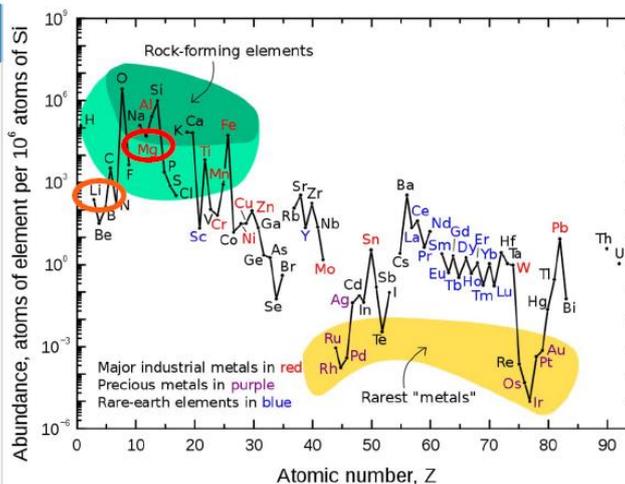
#### Magnesium-ion vs Lithium-ion

Magnesium is much cheaper and easier to find and produce than lithium

Magnesium is multivalent – its ions carry a double positive charge –vs- single positive charge carried by lithium ions

In theory, the energy density per unit volume of a magnesium ion battery is up to 170% of that of a lithium ion battery.

Lithium-ion batteries usually do not function properly at temperatures below -15° C magnesium batteries still work at temperatures as low as -30° C and as high as +55° C



#### Overview of listed MAGNESIUM focused companies (by market capitalization)

June 30, 2018		Trading symbol		Share price		Change	12 months		Total shares	Market cap.	
		June 30	Year-end	in %	prices		issued	million	million	local	US\$
		2018	2017		H	L	million				
American Manganese	NYSE AMYZF	US\$ 0.13	US\$ 0.22	-41	US\$ 0.28	US\$ 0.10	165.0	21.5	21.5		
MGX Minerals	CSE XMC	C\$ 1.07	C\$ 0.98	9	C\$ 1.96	C\$ 0.75	105.2	112.6	85.2		
Giyani Metals	TSX WDG	C\$ 0.21	C\$ 0.23	-9	C\$ 0.50	C\$ 0.20	81.8	16.8	12.7		
Element 25 1)	ASX E25	A\$ 0.20	A\$ 0.23	-13	A\$ 0.35	A\$ 0.13	83.50	16.7	12.3		
Korab Resources	ASX KOR	A\$ 0.03	A\$ 0.03	0	A\$ 0.06	A\$ 0.02	303.4	9.1	6.7		

1) name change from Montezuma Mining as at May 15, 2018