

## Manganese Q&A

### 1. What is manganese?

Manganese is a brittle, hard, grey-white to silvery metal with the chemical symbol Mn. It constitutes roughly 0.1 percent of the Earth's crust, making it the 12<sup>th</sup> most abundant element, and it is the 4<sup>th</sup> most used metal in tonnage behind iron, aluminium and copper. Manganese is mined as an oxide ore (the most important being pyrolusite, MnO<sub>2</sub>) and converted to ferromanganese or silico-manganese in blast or electric arc furnaces.

### 2. What is manganese used for and why?

Manganese is primarily used in the production of steel. Manganese helps remove oxygen and sulphur when iron ore (a compound of iron and oxygen) is heated. It is also essential in the alloying process, bonding with iron and other elements to create various types of steel. As an alloying agent it decreases the brittleness of steel and imparts strength. Manganese is also used in alloys with metals such as aluminium and copper. Important non-metallurgical uses include battery cathodes, soft ferrites used in electronics, micronutrients found in fertilizers and animal feed, water treatment chemicals, and other chemicals such as those used as a colourant for car undercoat paints, bricks, glass, textiles, and tiles.

### 3. Where is manganese found?

Land-based resources are large but irregularly distributed; key deposits are found in South Africa, Australia, China and Gabon as well as in Brazil and Ukraine. There are also large manganese occurrences on deep ocean floors in the form of polymetallic nodules.

### 4. Which country produces the most manganese?

South Africa.

### 5. How abundant is it?

Total land-based reserves across the globe are adequate to meet demand for the foreseeable future. Seabed mining is not yet economic.

### 6. How much manganese is consumed each year?

Consumption of manganese is approximately 19.6 million tonnes each year of contained manganese (equivalent to 52 million tonnes per annum of 38% manganese ore), predominantly by the steel industry.

### 7. What is the total annual production of manganese?

Total world production of manganese alloys reached 17.7 million metric tonnes in 2011. Global crude steel production reached another record high during the year, exceeding 1.5 billion metric tonnes for the first time.

Global production of silico-manganese (SiMn) in 2011 was 11.8 million metric tonnes, far exceeding the combined production of high carbon ferro-manganese (HC FeMn) and refined ferromanganese (Ref FeMn); HC FeMn production was 4.4 million metric tonnes and Ref FeMn was 1.6 million metric tonnes. SiMn is commonly used in the production of steel long products, critical components in the construction industry.

### 8. Who are the main manganese players?

BHP Billiton (ASX:BHP), Eramet, (EPA:ERA), Vale (NYSE:VALE), Consolidated Minerals (Private) and Anglo American (LSE:AAL)

### 9. What are the manganese market drivers?

Demand for manganese is primarily driven by the steel industry, which consumes 85% of manganese ore produced. The manganese market is highly concentrated with limited global suppliers – this should provide a natural pricing floor for manganese. However, 2014 has seen manganese ore prices drop, although Chinese ore imports have risen in recent months. Despite this, high grade ore (refined ferromanganese) prices are holding up well; this strength will depend on the trajectory of ex-China steel output.

### 10. Is the manganese market related to the iron ore market?

The manganese market is not related to the iron ore market. Manganese ore is much less abundant than iron ore and consequently the manganese price is significantly higher than the iron ore price (currently double the iron ore price per tonne). In addition, a large amount of iron for steel production comes from recycled steel and this is expected to grow in coming decades as China begins to recycle more steel. This will see iron ore usage taper off, however, recycled steel still needs additional manganese to be added to achieve the required chemical composition. As such, the manganese market is forecast to outperform the iron ore market due to increasing steel demand be it in new or recycled form.

### 11. How will manganese be sold by Ferrex when in production?

In the early years of production at Nayega, manganese ore grading 38+% is targeted to be sold via a marketing agent to various customers – likely in China, India and perhaps Europe. Once mining is established and additional studies have been completed on the viability of utilising a blast furnace to produce a high value HC FeMn, additional options for product sales will open up.

### 12. What is the average grade of manganese sold?

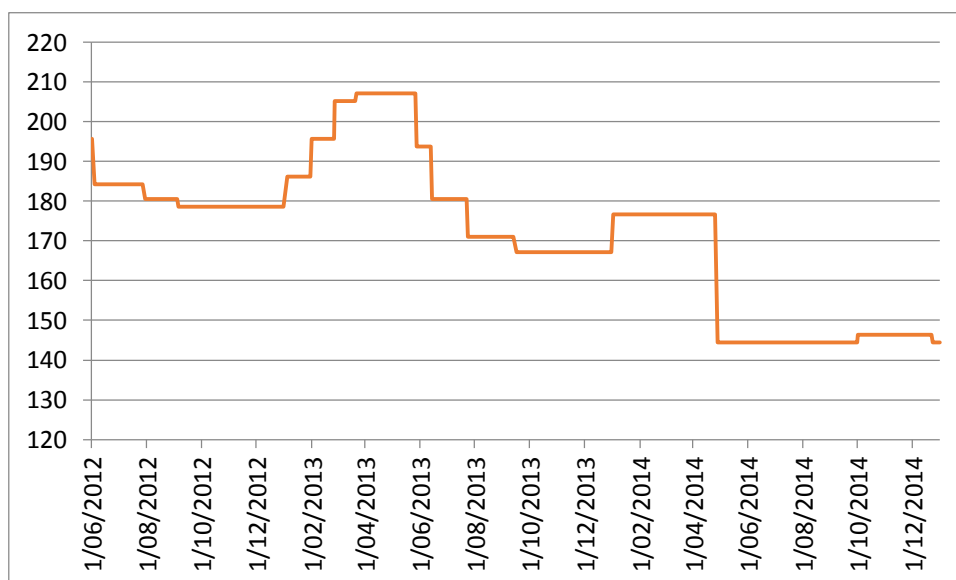
The seaborne market is dominated by medium to high grade ores (36-47% Mn). Low grade ores (<30% Mn) cannot carry transport costs and are used domestically, primarily in China, India and Ukraine. The average grade of the market is about 37% Mn.

### 13. How is manganese priced?

Manganese is priced in dmtu (dry metric tonne units); a 'unit' is 10kg, or 1/100<sup>th</sup> of a tonne. Contract prices are negotiated based on grade, levels of impurities (e.g. silica) and deleterious elements (e.g. phosphorous) as well as physical characteristics of the ore – a premium is paid for 'lump' (+6.3mm) over 'fines' (-6.3mm,+1mm).

### 14. What is the current price of manganese (January 2015)?

37.5% South African manganese lump is currently priced at \$3.80/dmtu CIF China (\$142.50/t) and \$3.20/dmtu CIF China (\$120/t) for fines (source ferroalloy.net). Most analysts believe the price for manganese has bottomed as shown by the graph below.

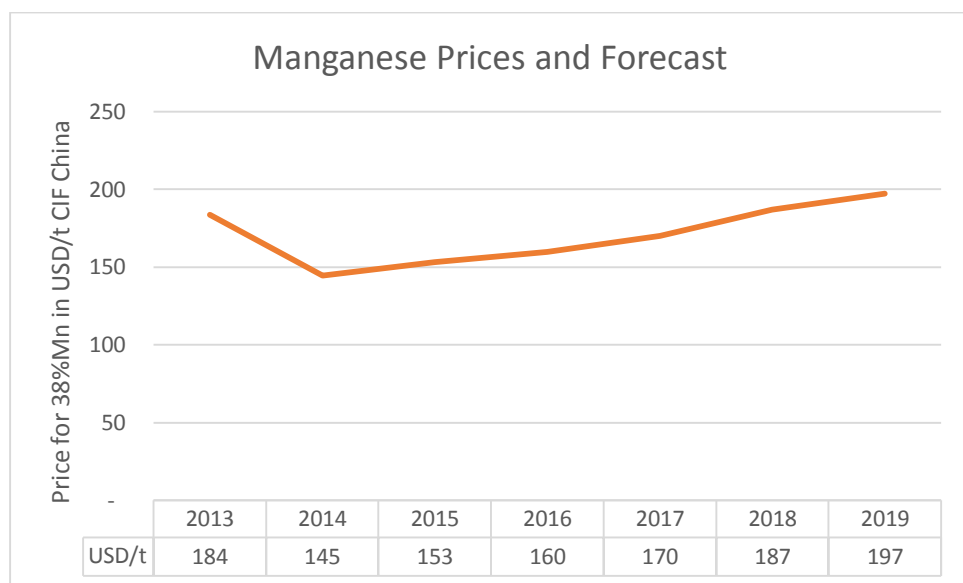


**Ferromanganese HC 75% material is currently priced at \$1,150/t Rotterdam (source ferroalloy.net)**

## 15. What is supply-demand like for the future?

After dropping off earlier in 2014, recent months have seen a steady and consistent rise in Chinese manganese ore imports – once more reflecting the availability of raw material supply. In particular, arrivals from Australia and South Africa are back to Q4 2013 levels. Despite this, port stocks have (finally) started to trend lower in months of imports, but there is certainly no problem with availability. Until these are drawn down – a process highly dependent on steel output, manganese ore prices will remain relatively depressed. However over the course of the next few years, there appears to be potential for sufficient supply of manganese ore from international suppliers, notably South and West Africa, to keep the market in balance. A recent report by the Bureau of Mines India suggests that India will have a 5mtpa deficit in manganese ore requirements by 2020 which will help underpin the manganese price in the medium term.

Macquarie has the following as forecasts for 38% lump CIF China which shows a gradual but steady increase (October 2014).



## 16. What new mines are being developed?

There are no significant manganese mines currently being developed after the recent expansion in South Africa.

## 17. Why Ferrex's Nayega Project?

Nayega is a low capex, low opex Mn (less than \$3.00/dmtu CIF China) deposit where conventional, well understood beneficiation techniques will be employed to produce medium to high grade ore suitable for sale to the seaborne market. Ongoing discussions with traders indicate there is significant interest in the product. Ferrex's management team, which has extensive experience developing mines in Africa, is confident Nayega will be the next new manganese mine.