Moving down the food chain of iron ore to meet growing demand

IRON ORE – from hematite to magnetite

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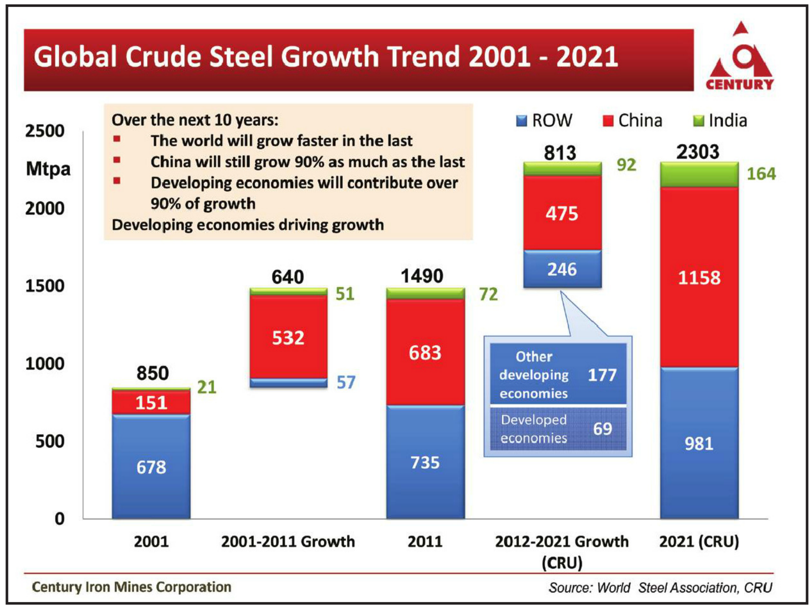

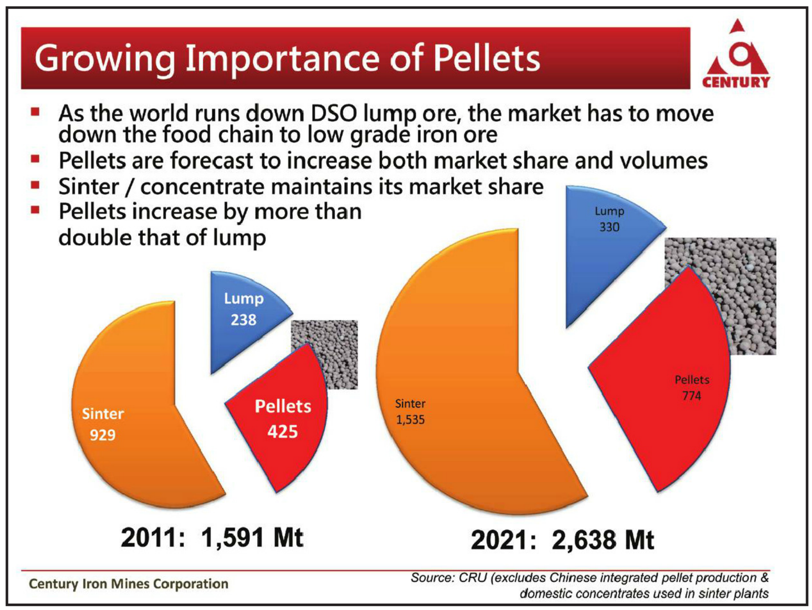

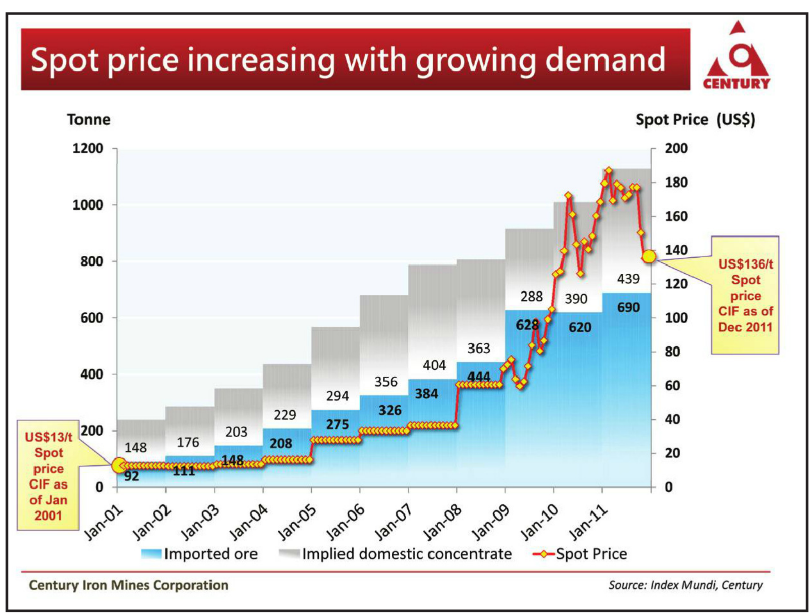

Contrary to popular opinion, the world of iron ore is quite colourful in terms of its original manifestations, in natural forms, as minerals or as products. In the steel making process, it can be quite confusing as to what types of iron occurrences are useful and what are not, or what are better and what are less desirable. It may be useful to look at this colourful world of iron in simple black and white, in order to grasp the basics of the iron ore industry, so as to be able to determine the value of iron ore as a mineral in the context of the various, important areas of the sector. The "black and white" in the iron ore world can be analogous to hematite and magnetite which are the two most common, basic forms of useful iron occurrences.

HEMATITE VS. MAGNETITE

Hematite (Fe_2O_3) and magnetite (Fe_3O_4) are the common forms of iron oxides in the Earth's crust and are the iron minerals that modern world uses to make steel. Some iron non-oxide may be useful but quite a few are harmful to the blast furnaces. The iron ore mining industry primarily looks for iron oxides to work with.

Generally speaking, magnetite is the naturally occurring mineral, in its original formation, with a distinctive magnetic property. The further oxidation of magnetite, in oxygen rich environments, turns magnetite to hematite; it loses its magnetic property. It is rather typical that such environmental and further naturally enriching (or even leaching through metamorphism) processes, over time, enriches the Fe content in the mineral. What we commonly see as the high-grade hematite, direct shipping ore (or DSO) is generally the case, such as in Australia and Canada,and other parts of the world. Though commercial DSO is high-grade hematite (about 60% Fe, an acceptable level at the blast furnaces), there are also, quite common, lower-grade (about 30%) hematite deposits around the world that can be economically concentrated.

During the last iron ore cycle, throughout the rebuilding of the Western economies after the World War II, generally only DSO or high-grade hematite was mined and shipped. In the US, when the high-grade hematite deposits were depleting, studies were carried out and the mining of low-grade (20-30% Fe) magnetite has become common practice. The magnetite that is mined in the US is from an iron mineralization called taconite which usually has a substantial minable portion of magnetite and a lesser portion of hematite which would be discarded as waste or tailings.

MOVING DOWN THE FOOD CHAIN

The world of iron ore supply, on a larger scale, has moved quietly from naturally enriched, high-grade hematite deposits to the naturally mineralized, low-grade magnetite deposits since the beginning of the super cycle. The transition has gone unnoticed as it is overshadowed by spectacular growth in volumes in response to demand. This necessary movement down the food chain of iron ore supply (mining lower-grade deposits) is driven by the ever increasing demand to make steel for developing economies, led by China. As the world is running out of high-grade hematite deposits, this trend will inevitably continue for many years to come.

The accompanying figures show the growth of the steel industry over the last 10 years according to World Steel Association and the next 10 as forecast by CRU, (an independent, privately-owned company that does market analysis) between 2001 and 2021. The global steel market grew almost three times over this 20-year period. Iron ore supply, having long cycles of development, has a hard time satisfying the need as we have seen in the record breaking spot prices over the last few years, even in the face of historical international financial crisis. For the 813 Mtpa (or million tonnes per annum) growth of crude steel over the next 10 years in this forecast, the world will have to produce 1.3 billion tonnes per annum more of iron ore which is roughly the total size of the iron ore seaborne market. Miners of iron ore will have to necessarily exploit lower-grade magnetite deposits to fill the demand.

Take the largest iron ore supplying country, Australia, which ships over 500 Mtpa as an example. Since the beginning of the iron ore industry there, Australia has been shipping high-grade, direct shipping hematite ore. All of the three major players, Rio Tinto, BHP and Fortescue, ship only hematite. However, as the high-grade hematite (enriched banded iron formation or BIF) rich Pilbara iron ore province has been staked fully by these major players, the rest of the players have moved to other iron ore regions like the Mid-West of the Yalgarn iron ore province which hosts much less enriched BIF, or magnetite deposits, where quite a few such projects have been springing up. This quiet movement toward magnetite, even in largest hematite iron ore country in the world, is very telling and is a reflection of the necessary path of evolution of iron ore supply in the future.

THE SUCCESS OF MINING MAGNETITE (OR TACONITE) IN THE US

The same trend took place also in the US when the enriched, high-grade, hematite deposits were running out during the building up of the US economy after World War II; the iron ore industry had to move to the low-grade (20-30% Fe) magetite deposits (basically taconite deposits are low-grade, hard, fine-grained BIF) in order to sustain the 100Mtpa steel making industry. Both the Mesabi Iron Range of Minnesota and Marquette Iron Range of Michigan are typical examples of this transformation. Today, these iron ranges mine the magnetite out of their taconite deposits constituting some 95% of the US domestic iron ore production. Taconite deposits have both magnetite and hematite present but usually it is the abundance of magnetite that makes the deposit economical.

One of the advantages of working with magnetite or taconite deposits is the simplistic, long established method of physical separation which involves the general crushing, grinding and multi-stage magnetitic separations. The process is simple and has flexibility of working with various grain and grind sizes to achieve optimum economic recoverability. Usually, water is used as the medium of separation that can best facilitate the process. Quite a fair amount of power is needed to grind down the ore to a fine size for better liberation. Water and power are key to the process, which are generally abundant and inexpensive in the US, making the process feasable. However, in dryer countries, mining magnetite may be challenging and sea water may have to be used after it is desalinated which is more expensive and polluting; coal fired thermal plants may need to be built to power the operation.

Those that produce iron ore out of US taconite deposits are either the integrated steel companies like the US Steel or horizontally integrated iron ore companies like Cliffs Natural Resources. Under the economics throughout the period before the super cycle, when iron ore was selling for below US $20 per tonne, the US iron ore industry survived on taconite mining. At the recent high levels of iron ore spot prices, as expected, companies like Cliffs have been performing much better than before. Cliffs, for example, recently reported a record net income of US $1.6 billion, reflecting a 59% increase from a year ago on a record 40 million tons of global iron ore sales with cash flow from operations of US $2.3 billion for year 2011.

In the US, iron ore industry, producers have taken advantage of North America's abundant water supply and inexpensive power (hydro particularly) to further add value by pelletizing their ore to make it more useful to the basic oxide furnaces (BOF), which work with primary iron.

Major Canadian Iron Ore Mining and Exploration Properties


60°N
60°N
Hudson Bay
9 Adriana Resources Inc. (ADI.V)
WISCO (China) (Jan 17, 2011)
Investing C$120M into Adriana
60% JV on the Lac Otelnuk Project
19.9% in ADI outstanding shares
Will arrange project financing for at least 70% of development cost as determined by a DFS
7 Millennium Iron Range (NML.V)
Tata Steel owns 27.4% NML
Sept 2010, Tata confirmed investing up to C$300 million & earn in 80% interest in the DSO projects
KeMag & LabMag total 9.1Bt PFS Resources (The Taconite Project)
March 6, 2011, Signed binding heads of agreement (the Binding HOA) with Tata Steel to develop the LabMag & KeMag iron ore deposits
Tata Steel will participate in the development of a feasibility study of the project and contribute towards 64% of the costs
NML shall have 20% free carry interest
2 Sunny Lake (Century)
55°16'31"N, 67°18'19" W
3 Attikamagen (Century and CHM.V)
54°56'56"N, 66°32'15" W
8 Labrador Iron Mines (LIM.TO)
12 Carol Lake (IOC/Rio Tinto)
Investing C$1B to increase capacity to 26Mt by 2013, and to 50Mt by 2016 on a yet to be determined budget
4 Altius Projects (Century)
1 Duncan Lake (Century and AUV.V)
850Mt 43-101 resources
53°28'30"N, 77°57'17" W
13 Mont Wright (QCM/ArcelorMittal)
Investing C$2.1B for mining complex expansion (May 20, 2011)
Increase production to 24Mt by 2013
5 Consolidated Thompson (Cliffs/CLM.TO)
WISCO (China) (July 20, 2009)
Offered US$240M for 19.9% of the project
Off-take agreement on 50% CLM's production
Cliffs Natural Resources Inc. (Jan 11, 2011)
Offered C$17.25 per share cash, transaction value of C$4.9B
14 Wabush Mine (Cliffs/Dofasco/US Steel Canada)
6 Fermont (CHM.V)
16 Kami Project (Alderon/Altius)
James Bay
Ontario
Schefferville
Newfoundland and Labrador
Labrador City
Wabush
Port Cartier
Sept-Îles
Gulf of St Lawrence
Saint John's
St. Pierre et Miquelon
Québec
Trois-Rivières
Montréal
Ottawa
Sherbrooke
New Brunswick
Fredericton
Moncton
Maine
Nova Scotia
Prince Edward Island
Thunder Bay
Hibbing
80°W
70°W
Labrador Trough
Canada
Greenland
United States
North Atlantic Ocean
México
Century Iron Mines Corp.
Major Canadian Iron Ore Mining and Exploration Properties
Drawn by : Diane Chung, MESci.
Date: Nov 3, 2011
Base Map Source: Google Map
Copyright Reserved
Information from management and publicly available sources such as company press releases and NI 43-101 reports are filed on SEDAR
CENTURY
Colour legend:
Projects owned by Century
Projects owned by Canadian companies
Projects owned by foreign companies
Scale:
0 200 400 km

Iron ore mining in the Mesabi Range of northern Minnesota. Photo by Sandy Chim.

Pellets command a high premium (from 15% to 40% more than concentrate, depending on market conditions) for it can replace the use of the more expensive lump DSO at the blast furance and help cut down the use of expensive coking coal.

As the world is running low on DSO, usually in lump form, the blast furnaces around world need to find a replacement product to replace the decreasing supply of lump DSO. Pellets fill this gap, as proven in the US, another reason for the success of mining magnetite in the US.

CRU forecasts, over the next 10 years, that the market share of pellets in the global iron ore market will grow faster than DSO lumps. This makes an even better case for taconite or magnetite mining, as the ore is already ground fine enough for pelletizing in its usual concentration process. In addition, the constancy of the pellet characteristics make them a welcome product to the blast furnaces and therefore another reason for premium pricing.

The successful and economically transformation in the US iron and steel industry is a good example illustrating a world facing the depletion of high-grade hematite deposits.

ROOM AHEAD

It is useful to reflect on the success of Consolidated Thompson's spectacular performance in taking Bloom Lake to production. The market did not quite believe that it would work despite other similar operations like Mt. Wright, Carol Lake and Wabush nearby, mining spectularite (which is a metamorphed taconite or metataconite having coarser grain which makes it effective in gravity separation for concentration and can be sold as concentrate alone). It is easy to dismiss an opportunity when nothing like it had occurred for some 30 years before. However, it did succeed and the market woke up to a $5 billion success story and is hungry for another.

With the projected strong, global, growth trend over the next 10 years, the global iron ore industry is moving from hematite to magnetite. There will be room for the market to accommodate the next wave of magnetite producers. ■