Lifton asks: is scandium the new gold?

Last week's Cleantech Conference in Toronto, organized by **InvestorIntel**, was a "hoot." It was proof to me that in Canada, at least, the Festival of the Rare Earths has been put to rest. Prospector-Geologists with their grab sample based dreams of "pounds in the ground" wishes are simply gone. OK, there is still a whiff of rare-earth – it is in the air as a new crop of niobium juniors list "rare earths" among their "deliverables," if not among their "payables."

But t'was separation technology that slew the rare earth beast, not low prices. Perhaps, in fact, it was the speculatively led attempted market cornering in 2012 that destroyed any hopes in the near term of non Chinese rare earths' production?

Projecting – because assuming made no sense and was just pure ignorance – that sky-high 2012 marginal rare earth prices would last forever, the wise (?) credentialed management boards and the punditocracy aided and abetted Wall Street, Bay Street, and Howe Street financial engineers to take candy from babies and canes and walkers (for resale) from seniors and common sense from everyone in between to enrich themselves.

The story was that because rare earths were "critical" or that, famously, the armies of the west would be helpless without them their prices could not help but defy both the law of gravity and the law of supply and demand. Therefore it was confidently put about that the speculative boom in rare earths prices was just a natural consequence of the revelation that China (the enemy ?) had a monopoly as well as a monopsony of the rare earths; it almost exclusively mined, refined, fabricated, and assembled consumer devices dependent on the rare earths for their operations. We could only buy such items so long as the wily Chinese deigned to allow us to do so.

Although the Chinese monopoly/monopsony meme was true in the case of the rare earths, it was also true for many equally or even more important technology metals and materials such as tungsten, graphite, germanium, and, interestingly enough, the more mundane magnesium and antimony.

The pirates of Bay Street, weaving their spell that the “price” of a scarce commodity is a measure of its value rather than of the difficulty of obtaining it, used this same story during the rare earth boom. That story was the idea that scandium, which had no commercial demand but many potential proven uses, was a new “gold.” This manifested itself in the idea that traces of scandium in rare earth deposits (always there) were “valuable” resources. No one will ever top the story that Molycorp “could/would” produce 50,000 tonnes of light rare earths and in that way also produce “7” tonnes of dysprosium (This would have required 100% extraction and separation capability and capacity at Mountain Pass, which was, and obviously is, impossible, to produce a trace material found in the ore body).

But now the scandium story is entering the hall of shame in preparation for the Memorial Molycorp Puffery, “The trace is the goal“ prize of the year.

First some facts; the rare earth story, as is the lithium story, the graphite story, and every other technology metal or material story, was and is an appeal in reality to technology in two ways. First there have to exist “commercial technologies”, i.e. mass producible ones, dependent for their operation on a technology metal or material enabler. Then there needs to be a separation and refining technology that can be applied to low as well as high grade ores and residues – first for extraction and then for recycling – in existence and proven to operate economically enough not to disturb the price-so called “disruptive” technology is not so much a scientific description as that of an economic breakthrough.

The quantitative chemical analysis of scandium is a difficult, so that one must first scrutinize any claims of precision in reports of minerals showing “grades,” for example, of 100 or less PPM of something like scandium.

Although the analytical spectral “lines” of Scandium (i.e. those energies which can be visualized by a spectrograph that are unambiguously caused by scandium) are well known separating them from the background in very small dilute samples is an art form as much as a technology. Forty years ago the same was true of the platinum group metals.

In fact a very scientifically experienced group, of which I am the least educated member, looking to recover technology metals from sea bottom sediments has been studying the credibility of scandium analysis regimens, and I have had the privilege of that information.

But the issues with scandium are:

- What is, if there is, a “scandium deposit”?
- How much scandium must be present in order to recover it “economically”?
- Does the surrounding elemental matrix inhibit or add to the “scandium” value? and, finally,
- Are there today applicable commercial technologies to extract, separate (i.e., refine) and fabricate scandium products for the current market?

First, and perhaps, most controversially, it is my opinion that there are no primary scandium deposits. Where scandium has been proven to be present it always presents at concentrations of no more than 500 ppm in situ. In fact, it is found most prominently as a trace in iron (and niobium) deposits associated with its chemical sister elements, the rare earths and yttrium, which in fact is chemically the nearest to scandium; they are both in, and constitute, a “column” in the Mendeleev version of the periodic table of the chemical elements.

The scandium in commerce today is produced in China and Russia from past residues, in Russia, and from modern processing, in China. It is unlikely that more than 10 tonnes a year are sold into the global marketplace.

Therefore, due to the tiny supply of scandium, only minimal commercial work has been done on it; mass produced consumer goods with scandium based alloys do not exist. There are some high-end golf clubs and baseball bats produced but these are rich men’s toys (positional goods – the ones that you have and the poorer guys doesn’t, such as an original Picasso).

However, during the last decade or so there has been enough scandium available for serious and fruitful laboratory scale scientific research on light metal structural alloys, which research has borne fruit. It is now clear that alloys with a small “atomic” percentage of scandium in aluminum and magnesium matrices show remarkable resistance to oxidation and exhibit unexpected strength. Therefore, if there were scandium available at a good price then the aircraft, marine, and land transportation industries would buy and use such alloys.

To summarize: scandium is a byproduct at best and in reality found mostly as a trace element in the rare earths. If it were not for the large increase in use of the rare earths since 1980, or so, there would be no sources of recoverable (economical) scandium at all.

Putting the scandium from rare earth occurrences in iron aside, modern analytical chemistry has also found that scandium is frequently (probably always) found as a trace in niobium deposits. Since there are only today three working sources of niobium, two in Brazil and one in Canada, even the presence of scandium traces in those deposits has been of academic interest only until now.

And the proposed development of additional sources of niobium has been used at present to spotlight the fact that, if sufficiently large quantities of niobium are to be recovered, then the possibility of coproducing scandium is also there. The Niocorp deposit in Nebraska (USA) is said to be able to produce 100 tonnes of scandium per year if it is produced as a coproduct/byproduct with 7,500 tonnes of niobium as Ferro Niobium. Note that this will be true only if a proven extraction/separation regime is developed. It turns out that the scandium must be extracted from the mineral mix at the beginning of any process or it will transport to the Ferro Niobium product from which it will not be recoverable economically. However, I am highly confident that the MRT process of IBCAT in Utah can, if placed correctly in the process flow sheet, extract the scandium at an early stage step the in hydrometallurgical treatment of the ore in an efficient and economical fashion.

I have been told by a niobium junior mine promoter that although the million tonnes of rock necessary to crush in order to provide 7,500 tonnes of (ferro?) niobium in Nebraska will provide 100 tonnes of scandium that CBMM with its annual production of some 55,000 tonnes of (ferro?) niobium has no scandium in its ore body. I however believe that it is more than likely that CBMM could produce significant tonnages of scandium (perhaps more than 500 tonnes per year) if its current process regime is amenable to the early removal of the scandium or can be economically modified to do so.

I am also highly confident that there is an anomalous and significant amount of scandium in the seabed sediments in Japanese waters and elsewhere in the South Pacific. And I believe the recovery of that scandium can be done economically with modern ocean floor mining technology.

Notwithstanding all of this, the issue (of course) is what will the future price of scandium be?

The law of supply and demand seems at first look to bode evil on this issue. Yes, in today’s market, scandium (as oxide) is selling for USD$1,500-3,000/kg, but what happens (say armchair economists with large and still spreading backsides) when the volume available “jumps” to hundreds of tonnes from tens of tonnes?

The answer is that not only will the current price of scandium hold but it may well increase a bit due to the fact that scandium usage just like that of niobium: that is, very low in any individual product and therefore does not contribute to the cost of that product significantly! The price for scandium does and always will be based on its scarcity and the difficulty of extracting, refining, and fabricating it as a raw material. And just as in the case of niobium and lithium it is in the economic self interest of the very few producers to keep the price stable and this maintain demand!

I note that although scandium metal has been produced “commercially” only by the “Ames Process,” and the electrolytic reduction of scandium salts dissolved in molten oxide eutectic, just as have and are the rare earths, it is possible that much better scandium will be able to be made commercially by vapor phase reduction of anhydrous chloride (NSP Corporation (USA)) and, or, by Solid Oxide Membrane Electrolysis (InfiniumInc (USA)). Both of these American high tech companies are located in the Boston area and are affiliated with or derived from the great American technological education complex there.

The scandium story has begun.