

Lifton on asteroid mining rare earths and Molycorp's Mountain Pass

Some rules don't change. But that doesn't mean that our poorly educated journalists have to know of them or even have to understand them, when they are described or applied. One rule, frequently swept under the rug by junior mining promoters eager to take advantage of journalistic ignorance can be stated as:

“In order for any deposit to be developed into a profitable mine the infrastructure to access it must already exist, or, if not, then its costs must be included in the feasibility study.”

Trivially this means for example no commercial mining until I can get to the deposit and either process the material to a commercial form at the site or move it to a processing site without logistics' costs destroying the project economics.

A corollary of the above “rule” is that the cost of infrastructure must be quantified and covered before the project enters development.

Now, the above rules of economics having been stated let's get to what I am talking about today.

Mining carried out at the margins of contemporary engineering and process technology has always been a science fiction theme. This idea either directly as a driver or indirectly as a justification, in fact, has served to advance the idea of extraterrestrial exploration and as a reason to survey the sediments of the ocean's bottom. Neither the immense pressures of the deep ocean or the hard vacuum of outer space has thus been a barrier to the imagination, but in the real world of

diesel-powered machinery using air as a source of oxidizer and of people who can only operate at all under narrow conditions of standard pressure and temperature-i.e., those that obtain on average at sea level on the surface of the earth-such mining has always faced not only the limitations of the human body but also infrastructure barriers.

Human adaptability and engineering have recently (in my lifetime) provided suits, in which, or machines, through or in which, people can operate under immense pressure or no pressure environments. However, so far, artificial intelligence (AI), AI has not progressed to the point where it can substitute at the drill point for an old man with an eye for minerals and a nose for grade. Remotely operated spectrographic equipment (sea-bed exploration) or gross long rang spectroscopy (astronomy) cannot yet even begin to substitute for hands on analysis.

Notwithstanding the fact that we (the human race) aren't ready nonetheless we are regaled this week with a stupid article about a "3 trillion GBP asteroid" passing by our planet. The promoter's universe in which we are presumed to live assumes that without exception none of us understand the law of supply and demand. Alas most of us do in fact understand this law, and so we are mostly not at all impressed by the truly dumb journalists who do not and never will understand the limits of science and engineering.

This week's treasure laden asteroid is fantasized, with no direct evidence whatsoever, to contain a million tons of platinum in its "core." The article's author and his/her editor simply multiply this number by the USD\$1500/troy ounce price for 99.99% metal that they find on the business page of *the Garbage Gazette* for which they work and the asteroid's fantasy deposit is "worth" 3.5 trillion GBP.

Let's assume for the sake of argument that we had access to up to a million tons of 99.99% platinum in the global 2015

marketplace of the planet Earth. The current world industrial demand for platinum mostly for automotive exhaust catalyst, but with a significant portion of demand for jewelry and some chemical engineering uses, is between 350 and 400 tons per year. Perhaps 60% of this demand is satisfied by new production from mines almost entirely in southern Africa. The rest comes from recycling of the scraps from the principle uses.

This would mean that the asteroid "deposit" would/could satisfy the needs of our society for platinum for some 2,500 years. Again assuming this is truly accessible the consequences would be economic chaos for the platinum markets. Such an immediate "supply" would collapse the price of the commodity essentially to ZERO, unless it could be economically produced at a slow enough rate. But even so that rate would have to be still at a cost low enough to compete with and replace the current supply marketed at (for argument's sake) USD\$1500/troy ounce. Even then it, the supply from the asteroid could only be increased so long as the increase did not distort the market and reduce the selling price due to overabundance.

But even if the "core" of the asteroid consisted of London Platinum and Palladium Market certified bars of pure platinum there will be logistics and engineering costs arising from such necessary engineering aspects as the following:

1. The asteroid will have to be put into an accessible orbit-it is now shortly just passing the earth. Its orbit could theoretically be adjusted to one either circling the earth or circling the moon. The moon would be better so that if there were an accident the asteroid would impact the moon rather than the earth, where a couple of million tons might be just enough for an extinction level event. However I note that the tonnage all of the warships of all of the combatant's in World War II was probably less than the total mass of this

asteroid, so we are faced with the question of just how much energy it would take to capture this asteroid (i.e., control its orbit). Thank goodness we don't have to lift two million tons into orbit from the earth's surface, since this would mean accelerating the two millions tons to some 14,400 miles per hour just to get it into earth orbit. Let's see what the back of my envelope says: Oh yeah, it would take all of the energy the human race has produced so far converted into liquid oxygen and hydrogen. Then, let's see we would have to build a fleet of spaceships, launch facilities, and so forth that would take the industrial and economic output of the USA for several years.

2. Wait, you say, you would only have to produce enough fuel and rocket engines for the rocket engines to be implanted in the asteroid to change its course. You're right and this would only take a few trillion dollars and I'll bet less than a generation. But wait, Oh darn, the asteroid is just passing the earth we may never see it again even if it's in orbit around the sun, so we have to do all the calculations, build the ships, build the engines, and produce the fuel for both the ships and the orbital transfer in a couple of months. Uh Oh – that's going to be tough for a world whose attention span is taken up by an immature "entertainer" licking donuts.
3. The recruiting, education, and training of thousands of engineers and astronauts who contribute nothing to our earth bound economy until the mine is producing,
4. The planning, design, manufacturing, and testing of "space suits" for humans and mining equipment for use in hard vacuum,
5. The design of transport vessels to carry the ore concentrates back to the earth,
6. Facilities to process and refine the ore concentrates, and
7. A political solution to the twin problems of who pays

for all of this and what do they get out of it?

Funny I didn't see anything about any of the above things in the newspaper story.

But since we would have to in any case restrict the supply in order not to distort the market let's look a little further to see if this problem has arisen before.

Gee whiz we only have to look at the rare earths markets right now today on terra firma to see what happens to price when supply exceeds demand. But even here there is a further complication: **The supply of all of the rare earths is not in surplus**; it is just the supply of the lower atomic numbered rare earths, lanthanum and cerium, that is in oversupply. *So why are the prices of all of the market critical rare earths trending downward rather than firming?*

One answer would be that the production of the KEY rare earths, neodymium and praseodymium, is determined by the production of lanthanum and cerium, because the overwhelming majority of Nd and Pr is and must always be co-produced with La and Ce. This is how these elements are nearly always found in nature. Whenever anyone presents you with an elemental analysis of a "rare earths deposit" always look at the key ratios:

1. Nd and Pr/TREO
2. Nd/Pr
3. SEG/TREO, and
4. HRE/TREO
5. HRE + Y

I was present in the Spring of 2013 in Ganzhou at a CSRE/ACREI joint conference where the General Manager of the world's largest vertically integrated producer of light rare earths located in Bayan Obo, Inner Mongolia, said that he was now forced to overproduce La and Ce in order to keep up with the demand for Nd and Pr.

With that in mind look at the above ratios for the three highest grade light rare earth projects in production today:

	Molycorp Mountain Pass	Lynas Mt. Weld	Baotou
Nd and Pr/TREO	16.3	23.4	21
Nd/Pr	3	3.6	4
SEG/TREO	1.1	4.1	2.1
HRE/TREO	0.2	0.47	0.25
HRE + Y	0.3	1.23	0.55

Note that outside of China not only does Mt Weld have the best distribution going for a large high grade accessible deposit but it is in fact better in SEG and HREEs than Baotou by a factor of two.

But as we know the established rare earth markets and the demand geography for the rare earths overwhelmingly favors China.

Humor me and let's look at the above metrics for my favorite three US deposits:

	Bear Lodge	Bokan Mountain	Round Top
Nd and Pr/TREO	23	16	7.2
Nd/Pr	3.6	4.3	2.7
SEG/TREO	5.15	7.7	3.8
HRE/TREO	0.74	10.1	26.7
<i>With Y added to the HREs for HRE/TREO one gets:</i>			
HRE + Y	2	36	70.1

- Bear Lodge – Rare Element Resources Ltd. (TSX: RES | NYSE MKT: REE)
- Bokan Mountain – Ucore Rare Metals Inc. (TSXV: UCU | OTCQX: UURAF)
- Round Top – Texas Rare Earth Resources Corp. (OTCQX: TRER)

Clearly (with Thorium and Uranium content eliminated) the USA deposits above are far better balanced in market critical rare earths than all the current producers outside of China but Lynas.

It is clear that the total demand for rare earths for the manufacturing of rare earth permanent magnets is limited by how much neodymium or didymium (neodymium plus praseodymium) is produced. It may well be that there is not enough new Nd + Pr being produced to allow any substantial increase in the production of rare earth permanent magnets even though there is enough being produced to satisfy the current demand. Therefore the prices of the magnet critical HREs are depressed as demand for them is lessened. But as the markets move to support high Nd+Pr producers such as Lynas the demand for the magnet rare earths, Tb and Dy, will once again increase and prices will go up.

China has and has been producing from HRE dominant deposits.

To be charitable the original investors in the revival of Molycorp did not understand that the market critical rare earths are more important than lanthanum and cerium. Nor did they understand, or know of, or use the 5 metrics above.

The continuation of Lynas is by no means assured, but support for its existence by Japanese investments in off-takes and even in facilities finance indicates that the Japanese have learned a lot more about the rare earth markets than many who invested in Molycorp.

Events are moving rapidly. If the world's economy, and, in particular, that of the USA and/or Europe resumes a 4% growth rate then the end-use markets for the market critical rare earths will resume its steady growth. Then and only then will commodity prices rebound. China probably today has the power to create the necessary uptick in the growth of global GDP. And, in fact, this is the probable result of the new goal of re-setting the Chinese domestic economy away from one that is export-led to one that is domestic consumption-led.

The world's economy is struggling to resume steady growth. Asteroids will come and go, and in fact there will be asteroid

mining one day, but it will be for local use and the most precious of all mined goods will be ICE (water). Think about that. What else can you use to produce fuel (hydrogen and oxygen), atmosphere, and a medium in which to grow plants?

[Disclaimer: Please review Jack Lifton's bio below where he lists his clients and Board positions.]