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Commerce Resources Corp.'s Ashram Rare Earth Element Deposit: Checkers Instead of Chess

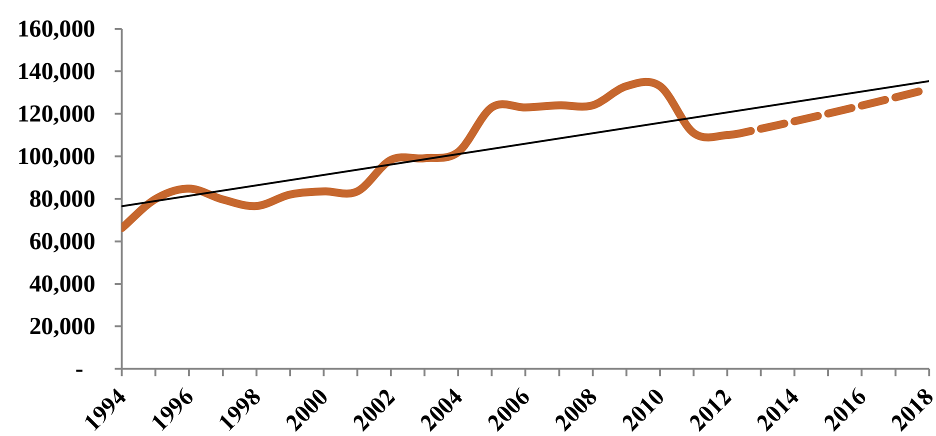
RESEARCH & OPINION

DEREK HAMILL
Research & Communications
Zimtu Capital Corp.
dhamill@zimtu.com

Summary:

1. *Owing to the extensive processing required, economic mining of a deposit is more likely to be determined by the host mineralogy, REE distribution, and product simplification (i.e. mixed REC) for junior public companies developing a resource.*
2. *Beneficiation of ore into a mixed REC can be sold to various hydrometallurgical processors – CCE's strategy. For juniors with limited access to capital, trying to initially process ore through to separated products (SREO) adds substantial unwarranted business risk.*
3. *CCE's material update, dated 19th of August 2014, improves the metallurgical flow sheet for Ashram. At bench scale, mineralized material from Ashram was able to achieve above 40% TREO with a 97% mass reduction while retaining 70% cumulative recovery. This allows for the rejection of more gangue and problematic elements, ideal for metallurgical processors.*

Global Annual Rare Earths Production



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Introduction – in through the out door

The rare earth elements (REEs) are a group of 17 chemically similar elements that include lanthanum through lutetium (atomic numbers 57 through 71), plus yttrium (39), and often scandium (21). In the mineral exploration industry, scandium is not considered a rare earth element and is not included in grade calculations as it does not always occur in the ore minerals, and thus, not associated to the same degree as the other REEs.

Although the crustal abundance of some REEs is comparable to copper or zinc for example, they rarely concentrate into economically exploitable deposits (Table 1). Further, due to their chemical similarities, the separation of the individual elements from the host mineral presents a material challenge; originally it was this challenge that led to the term “rare earth”.

Table 1. Rare Earth Elements With Downstream Application

Element	Atomic Number	Crustal Abundance (ppm)	Downstream Sector Application
Lanthanum	57	32	Petroleum cracking catalysts, batteries (NiMH)
Cerium	58	62	Autocatalyst, glass, polishing
Praseodymium	59	9	Magnets, glass
Neodymium	60	33	Magnets (NdFeB)
Samarium	62	7	Magnets, (SmCo)
Europium	63	1.8	Phosphors, nuclear control applications
Gadolinium	64	6	Intravenous contrast agents, phosphors
Terbium	65	0.94	Phosphors
Dysprosium	66	6	Magnets (NdFeB), lasers
Others (Ho, Er, Tm, Yb, Lu)	67-71		
Yttrium	39	29	Phosphors, metal alloys

Source: UNCTAD and AIMR 2013

It is the inherent nuances of concentration, REE distribution, beneficiation, extraction, and separation of rare earths within a deposit that complicate the economic picture well-beyond grade and tonnage. This fact, has become startlingly apparent as Molycorp (NYSE: MCP) struggles to ramp up production from Mountain Pass while dealing with numerous operational setbacks, supply constraints for hydrochloric acid in North America, and downward price pressures for many light rare earth elements (LREE).[2]

Investment Strokes – the smoking gun

Market structure intricacies for REEs include:

- Critical and unique product inputs for many technology and chemical products, i.e. magnets, batteries, catalysts, and phosphors
- China is the dominant player, controlling roughly 85% of the market
- REE processes are commonly sensitive and proprietary, making relevant and reliable information difficult to find.

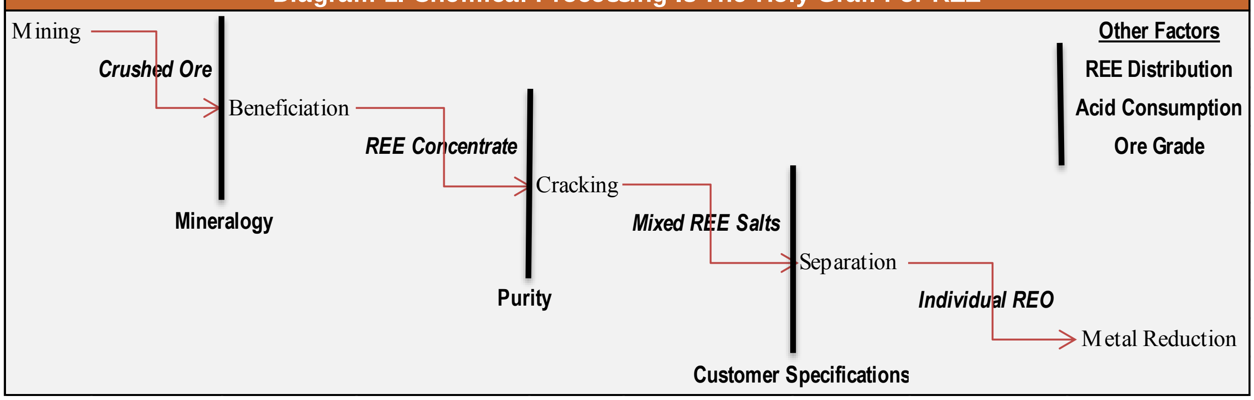
[2] Molycorp 2013 Annual Report, Notes

Fear of Chinese market manipulation and the resulting rare earth oxide (REO) price spikes throughout 2009 to 2012 led to the inception of hundreds of REE projects globally.[3] In the case of opaque markets that experience sudden and violent price volatility, subjective conjecture often masquerades as objective and researched. For rare earths, this tends to include aggressive demand growth estimates, and new supply assumptions that seem to trivialize historically relevant technological impediments such as host mineralogy.

The reality of the situation is that many investors may have underestimated the investment of time and capital required to tailor an economically feasible metallurgic flow sheet and build a sufficient customer base. In practice, there is no global exchange, and storage of standardized REO and REM (rare earth metals) is not feasible. This means customers must be sought out and their individual product specifications met.

A good summary statement for rare earth production is provided in the 2013 annual report for Lynas Corporation Ltd. Chairman Nicholas Curtis wrote, *"Commercial production of rare earths is a much more complex and capital-intensive undertaking than production of many other mineral commodities. In reality, our business is as much about chemicals processing as it is about mining. Supplying our customers with refined rare earth products is only possible after an exhaustive process involving mining, crushing and concentration of ore, followed by cracking, leaching, purification, separation, and final processing to meet specific customer product specifications. Then follows a qualification process……when the customer concludes their specifications have been satisfactorily met."*[4]

Diagram 1. Chemical Processing Is The Holy Grail For REE



Source: British Geological Survey

Mr. Curtis provides a wealth of clarity for an industry seemingly shrouded in subterfuge. Many casual observers of the mining industry may be inclined to evaluate rare earth deposits in a similar manner to other mined mineral deposits – size, grade, production output, and required capital investment. In fact, this sort of thinking may even permeate downstream manufacturers, explaining the current pessimism in the sector. After all, both Mountain Pass and Mount Weld, hosting significant concentrations of rare earth oxides (REOs), appear economically challenged. Meanwhile, prices for REOs have fallen materially after exponentially increasing through 2010 and the first half of 2011. Given these parameters and the current state of the rare earth market, potential investors and strategic partners may find the case for developing Ashram confusing; if Mountain Pass has yet to prove economic feasibility, how can Ashram with its lower in situ REO grade?

[3] Rare Earth Elements, British Geological Survey, November 2011, page 28
[4] Lynas, 2013 Annual Report, Chairman's Letter

The answer lies in the characteristics of the rare earth deposit (outside of just REO concentrations, i.e. grade) and the significance of metallurgy in producing an economic saleable product (Diagram 1). True, increasing concentration of the desired commodity means less gangue (waste) and, all else equal, lower operating costs to mine the ore.

However, for REEs, grade matters less than one might think. For example, ion-absorbed deposits, such as those of the South China Clays, are associated with grades of 0.03-0.35% REO, yet are very economical due to the process of natural weathering, a distribution skew toward the HREE, and very simple and low-cost metallurgy.[5]

Arguably, due to the extensive processing required, economic mining of a deposit is more likely to be determined by the host mineralogy, distribution of specific REEs, and product simplification (i.e. mixed REC) for small capitalized (junior) companies developing a resource. We believe the last point to be material and often ignored – beneficiation of ore into a mixed REC can be sold to various hydrometallurgical processors who then can separate into customer specific REOs. For junior companies with limited access to capital, trying to initially process ore through to separated oxide products (SREO) adds substantial business risk.

Mineralogy – do not pass go

REEs are a unique type of commodity in that all of them occur together in the same mineral due to their similar chemical properties. Therefore, one must deal with all of them just to isolate the targeted element(s) as not all have ready markets. To further complicate matters, REEs occur in over 200 minerals, nearly always in groups that carry the grade in a deposit, and often do not respond to processing the same. Therefore, rare earth deposits hosted in minerals not normally associated with economic recovery face significant technical barriers and increased costs, to achieve commercial production. Simply put, this means mineralogy is paramount as it directly impacts the economics of metallurgy, and is therefore a foremost determining factor in the viability of the entire project.

Due to these aforementioned attributes of the REEs and their occurrence, current and past commercial processing is dominated by only three minerals; monazite, bastnaesite, and xenotime. Note that the ion-absorbed clays do not recover minerals in their processing; only ion-absorbed REEs are liberated and able to be recovered directly, indicating no REE-bearing minerals are involved. This leads to the conclusion, the largest competitive advantage a rare earth deposit can have would be its mineralogy.

Almost from inception, Commerce Resources made a conscious decision to allocate material resources toward the metallurgy of Ashram as it is hosted by these three minerals that dominate commercial processing. The idea being, demonstrating that the metallurgy was cost effective, thereby significantly de-risking the project from a rare earth deposit's most common showstopper; mineralogy (Table 2).

Table 2. Ashram Bench Scale Beneficiation to a Mixed REC

Test Stage	Test 1				Test 2			
	TREO Grade	Stage Recovery	Cumulative Recovery	Mass Pull	TREO Grade	Stage Recovery	Cumulative Recovery	Mass Pull
Whole Rock	2%	100%	100%	100%	2%	100%	100%	100%
Flotation	9%	81%	81%	17%	9%	81%	81%	17%
HCl Leach	18%	100%	81%	8%	17%	100%	81%	9%
WHIMS	44%	88%	71%	3%	41%	87%	70%	3%

Source: Commerce Resources

[5] Rare Earth Elements, British Geological Survey, November 2011, page 11

Distribution – Bible on the dash

Though REEs are found together, initially processed together, and for ease generally referred to as a single commodity, it is important to note they are not the same. Some REEs have little or no practical use, others have wide applications. Light rare earths (LREE) generally include elements with atomic numbers 57 to 64 (Ce, La, Pr, Nd, Sm, Eu, Gd), while the heavy elements (HREE) include atomic numbers 65 to 71 (Tb, Dy, Ho, Er, Tm, Yb, Lu). Occasionally, the literature references a third classification known as the medium rare earths constituting atomic number 62 to 64 (Sm, Eu, Gd). LREEs are much more common than HREEs; a fact shared by most deposits globally. However, various minerals will host a unique distribution of the REEs. As the global supply for individual REEs is unequal and faces different demand frontiers, the threat of oversupply or supply shortage is different for each usable rare earth. Importantly, HREEs had little or no use prior to the 1990's, meaning there was little value in individually separating these elements. The recent growth in applications for HREEs translates into comparative advantage for deposits with rare earth distributions favoring the heavies.

In the United States (US), the issue of rare earth criticality has been considered by both the Department of Energy (DoE) and the Department of Defense (DoD). Between them, the REOs most critical to alternative energy technology and military hardware are neodymium (Nd), europium (Eu), terbium (Tb), dysprosium (Dy), erbium (Er), thulium (Tm), and yttrium (Y). This is especially true in the face of forecasts sighting material risk of supply shortfalls for Nd, Tb, and Dy.[6]

Lynas Corporation released a presentation titled "Rare Earths – we touch them everyday" in May 2014 with current product demand growth expectations (Table 3). These expectations echo Molycorp estimates as well as various industry analysts. The magnet industry is currently the largest consumer of REOs and is poised to close out this decade experiencing nearly a 10% compound annual growth rate.[7] Magnets utilizing REOs are found in wind turbines, automobiles, hybrid and electric vehicles, industrial energy efficient drives, and electronics.[8] The NdFeB magnets are the highest performance permanent magnet materials available, and though Dy and/or Tb do not represent the majority of total rare earths used, these HREEs are integral for peak performance at elevated temperatures.

Table 3. Rare Earth Industry Growth

Sector	2014 Demand Est. (tonnes)	REE Used	CAGR	2018 Demand (tonnes)
Permanent Magnets	29,700	NdPr, Dy, Tb	9.7%	43,011
NiMH Batteries	12,100	La, Ce, Nd	10.1%	17,780
Fluid Catalytic Cracking	14,300	La	8.0%	19,455
Metallurgy	14,300	CeLa	3.0%	16,095
Polishing	12,100	CeLa	4.2%	14,264
Autocatalysts	8,800	Ce	5.9%	11,068
Phosphors	7,700	Eu, Tb, Y, Ce, La	-1.2%	7,337
Other	11,000		3.6%	12,678
Total	110,000		6.5%	141,688

Source: Lynas Corporation, UNCTAD, and USGS

[6] Commodities At A Glance, Special Issue on Rare Earth, United Nations Conference on Trade and Development (UNCTAD), 2014
[7] Rare Earths – we touch them everyday, Lynas Corporation, Capital Raising and Business Update, 5 May 2014
[8] UNCTAD, Molycorp, and Lynas Corporation

Considering current price compression for most LREEs, the material growth in catalysts for two sectors in particular should help mop up the current oversupply of La and Ce. La is used in cracking of oil and gas fluids – an integral technology helping to reshape the US energy landscape. Ce is used in automotive catalytic converters. The global automotive industry is experiencing, what could only be referred to as, a renaissance due to continued growth of Chinese vehicle ownership. In fact, China is on pace to break the 20 million unit mark for new car sales in 2014; in comparison, the US is on pace to achieve 16 million new car sales this year.

To compare like-with-like, we ignore resource grade and focus on the value of a 1 kg mixed REC (assuming 100% TREO) prior to separation of individual REOs. Though this is a stylised example, the results of the comparison in the current pricing environment illustrate the distribution value for Ashram (Table 4).

Table 4. Distribution and Blended Value of Separated REOs

Separated REO	Oxide 99% min FOB China		Ashram	Mountain Pass	Mount Weld
	Feb 2014 (U$/kg)	Sep 2014 (U$/kg)			
La	5.70	*5.05*	24.6%	34.0%	23.9%
Ce	5.25	*4.75*	45.8%	48.8%	47.6%
Pr	122.0	*119.5*	4.9%	4.2%	5.2%
Nd	67.50	*58.50*	17.0%	11.7%	18.1%
Sm	9.00	*5.50*	2.3%	0.8%	2.4%
Eu	950.0	*725.0*	0.6%	0.1%	0.5%
Gd	46.50	*46.50*	1.4%	0.2%	1.1%
Tb	825.0	*625.0*	0.2%	0.0%	0.1%
Dy	465.0	*340.0*	0.6%	0.0%	0.3%
Y	20.00	*13.50*	2.6%	0.1%	0.8%
September REO Basket Price (U$/kg)			*32.21*	*17.22*	*26.24*

Source: Company Filings, AIMR 2013, and Metal Pages

Purity – dark horse

REE mineralization is frequently associated with radioactive elements – thorium, uranium, and their related daughter products. While part of the deposit, there is very little risk as the in situ concentration is marginal. However, during concentration of the REE host minerals the radioactive phases may also be concentrated, posing health and environmental risks. The procedures and containment necessary to properly handle, secure, and dispose of this material could potentially represent significant cost. Some have argued that accumulated thorium could eventually be sold and should be thought of as an asset. However, the international accounting framework defines an asset as 'a resource controlled by the entity as a result of past events and from which future economic benefits are expected to flow to the entity'. Since, there are no commercial thorium cycle reactors worldwide, accumulated radioactive materials are likely to be treated as a provisional liability.

Looking at REC from producers outside China and excluding Molycorp, we can see how favourably Lynas' concentrate compares with both Indian Rare Earths Limited (IREL) and SMW of Russia owing to lower thorium and uranium accumulation (Table 5).[9] Similarly to Lynas' LAMP deposit, Commerce Resource's Ashram deposit is dominated by carbonatite-hosted monazite, and is likely to compare most closely to the LAMP concentrate. This bodes well for the low radioactive element character of future Ashram concentrates.

[9] A. Golev et al./ Resource Policy 41 (2014) 52-59, Rare earths supply chains: Current status, constraints and opportunities

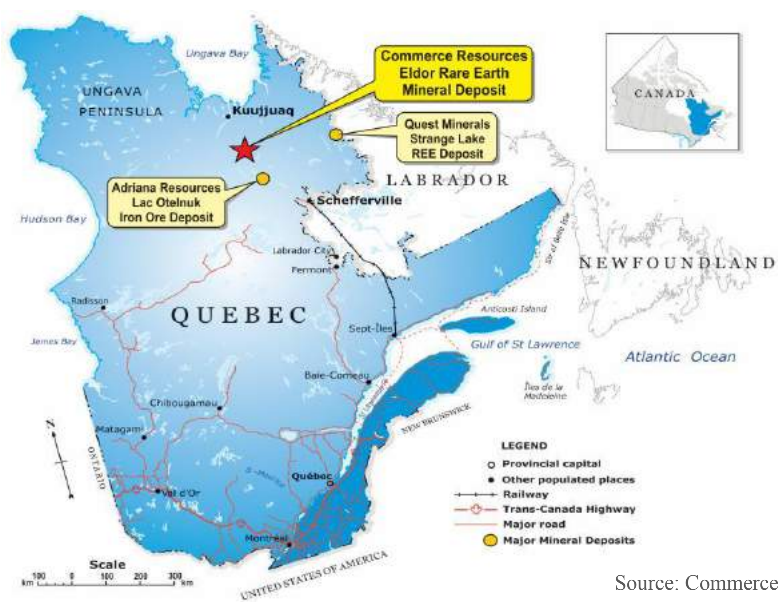
Table 5. Sample of Radioactive Content for Different RECs				
Company, Country	**Mineral Concentrate**	**REO (%)**	**ThO_2 (ppm)**	**U_3O_8 (ppm)**
IREL, India	Monazite	57	92,000	3,500
SMW, Russia	Loparite	31	7,000	200
LAMP (Lynas), Malaysia	Monazite-carbonatite	40	1,600	29

Source: A. Golev et al. / Resource Policy 41(2014) 52-59

Concluding Remarks – when it just has to work

The market for end-use applications of rare earth oxides (REO) and rare earth metals (REM) is different than many other mined commodities. The market size, measured by volume, is small at 110,000 tonnes[10] in 2013, and operates without a developed exchange.[11] Yet, the contributions of REEs are vast and for certain technologies – indispensable. Unlike more well-known commodities whose end-users adapt product specifications to utilise the available processed supply (such as copper wiring), the REO and REM supplied must meet customer specifications. Therefore, there is a qualification phase between participants along the value chain.

For Commerce Resources, this means being able to provide hydrometallurgical processors with a consistent supply of high purity mixed REE concentrate that meets the environmental tolerances and downstream required specifications. This was the significance of the message delivered in Commerce's update, dated 19 August 2014, regarding the metallurgical flow sheet for Ashram. At bench scale, mineralized material from Ashram was able to achieve above 40% TREO with a 97% mass reduction while retaining a 70% cumulative recovery of REEs.[12] This allows for the rejection of more gangue and problematic elements before the material enters downstream processing. This reduces costs to a potential hydrometallurgical processor seeking to meet customer specifications. Clearly, this is an important achievement for Commerce Resources as it suggests strong potential for Ashram to produce a high purity REC ideal for hydrometallurgical processors at competitive operating costs.



Source: Commerce Resources

[10] USGS, Rare Earths
[11] China recently initiated a rare earth exchange, Baotou Rare Earth Product Exchange
[12] Commerce Resources Updates Metallurgical Flowsheet and Outlines Next Steps for the Ashram Rare Earth Deposit, 19 August 2014

The Ashram Deposit hosts a well-balanced rare earth distribution, plus relatively significant enrichment over all five of the rare earths considered to be 'critical' (Nd, Eu, Tb, Dy, and Y). Within the overall resource, there exists a zone of more intense Middle and Heavy Rare Earth Oxide (MHREO) enrichment, termed the 'MHREO Zone'. The 2012 preliminary economic assessment (PEA) for the Ashram stated an Measured & Indicated (M&I) resource of 29.3 million tonnes at 1.90% total rare earth oxide (TREO) and an inferred resource of 219.8 million tonnes at 1.88% TREO based on 15,692 metres drilled. The PEA is based on a 4,000 tonne per day open-pit operation with a mine life of over 100 years if the open-pit and underground are developed. These figures include M&I resources from depths below the proposed pit. Additional infill drilling of over 2,700 metres has likely increased the M&I resource for the open-pit closer to the 36 million tonne target believed to be necessary for the pre-feasibility study. We view the latest bench scale metallurgical news as yet another positive indication that CCE's management team is executing a proper sequential de-risking of the business case, and so are moving the resource forward in a responsible value accretive manner.

We look forward to CCE's stated next steps, including optimizing specific aspects of the mineral processing flowsheet and initiating downstream processing studies toward the production of a cerium-lanthanum depleted, thorium free, mixed REC. This is one of many potentially saleable products and is the preferred feed stock for many REE processors.

Derek Hamill
Research & Communications

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