Eleven Rare Earth Companies to watch, including Molycorp, Lynas, Greenland Minerals, Avalon, Arafura and more

The companies reviewed below cover a variety of business models in the rare earths space. This article follows on from Rare Earth Elements: The Seventeen Metals Crunch

Factors to consider when reviewing the explorer/developers include the skills base within the company, the likely access to capital (rare earth projects are expensive), the political risk and the required infrastructure (many are in remote places). The development stage of the project is also an important consideration as (a) rare earth projects are complex and take longer than those of other commodities particularly as they require a pilot plant to test the complex metallurgical process and (b) in a relatively small market first mover advantage is important.

Particularly crucial too is the quality and metallurgy of the orebody: Is the mineral amenable to REE recovery? Are there contaminants and if so how will they be treated? What is the grade of the REE? What proportion of the resource are valuable heavy rare earth elements and what proportion is light?

Lynas Corporation (ASX:LYC, Market Capitalization: AUD$2.5 billion)

ASX-listed Lynas Corporation owns the richest deposit of rare earths in the world, it should be the next rare earths producer off the block, and it is the largest of the companies in this review. Its stated aim is "to create a reliable integrated source of Rare Earths from mine to market and to become the benchmark for the security of supply and environmental standards in the global Rare Earths industry".

The company has two projects underway. It is developing a mine and concentration plant at Mount Weld in Western Australia. The mine is complete and the concentration plant due to come online in December 2010. It is also building a state of the art Rare Earths processing plant, the Lynas Advanced Materials Plant (LAMP) near Kuantan in Pahang, Malaysia where production is scheduled to commence in the third quarter of 2011.

Mount Weld is situated some 700km+ from Perth near to the town of Laverton. It hosts the Mount Weld carbonatite, a 3.5km diameter near-vertical plug which in turn hosts two rare earth deposits. The Central Lathanide deposit is the richest in the world with an REO grade of 10.7%. The estimated resource for the nearby Duncan deposit (formerly called the Southern Zone) has just been increased threefold. The combined rare earths estimate for the two deposits now stands at 17.5M tonnes at 8.1% REO, for a total contained REO of 1.416 million tonnes.

The open pit has already been constructed and there are stockpiles sitting at the surface. These will be concentrated in a plant 1.5km from the mine then shipped in sea containers and transported by road and ship to the processing plant where the concentrate will be processed into separate Rare Earths products. Lynas selected Malaysia for the LAMP due to the readily available industrial infrastructure, including land, energy, water, re-agents from local suppliers and a port that can manage container, chemical and bulk shipments. The area where the plant is being built also offers much knowledge infrastructure, such as technical and trade skills and chemical industry experience. The government
infrastructure is in place and provides accountable regulators, clear legal frameworks and FDI incentives. Lynas already has a number of supply contracts in place.

**Molycorp (NYSE:MCP, Market Capitalization: US$2.2 billion)**

Molycorp was formed in 2008 to reopen the Mountain Pass Mine and processing facility in California which was mined from 1952-2002 and was the world's largest source of rare earths from the mid-60s to the early 90s. The company immediately began to manufacture rare earth products from surface stockpiles, primarily to develop its processing capabilities but in doing so it also generated a little cash flow ($2M in 2008 and $7M in 2009) and became the only current producer of rare earths in the Western Hemisphere. In July 2010 it raised $393M in an IPO on the New York Stock Exchange which it will use to fund its "mine to magnets" strategy whereby the company plans to recommence all operations by 2012 and become a fully integrated producer of rare earths products, including oxides, metal alloys and magnets.

Rare earths were discovered by chance at Mountain Pass when uranium prospectors sent samples to the USGS for analysis in 1948. The Molybdenum Corporation of America, (later renamed Molycorp), acquired the mining rights, production began in 1952, an expanded concentrator was built in the 1960s and a new separation plant in the 1980s. At its peak the mine was producing around 70% of world supply. However processing at the mine stopped in 1998 following some wastewater leaks, while mining stopped in 2002 as a result of the lack of a permit to build a new tailings dam. Ownership of the project has changed hands several times with the original Molycorp acquired by Unocal which in turn was acquired by Chevron Mining. In June 2008 the privately-held Molycorp Minerals, (which had some personal links with, but was not a direct successor to the original Molycorp), was set up to acquire all the Mountain Pass assets from Chevron.

Molycorp's current plans and "mine to magnets" strategy are summarised in its IPO prospectus from July 2010. In essence these include plans to:

- Reopen the mine: The mine is located in the Mojave desert in California an hour down the road from Las Vegas. It has huge, high-grade reserves, (although these are skewed towards the less valuable light rare earths), and a 30 year mine plan permit and environmental impact report, both issued in 2004.

- Refurbish, modernise and expand the processing facility in order to achieve planned production rates by the end of 2012: Molycorp has invested considerable sums into optimising REO recoveries. Its stated goal is to produce the "largest, most advanced and efficient fully integrated REO processing facility in the world".

- Manage costs in order to be cost competitive: Plans include programs to reduce energy requirements, water consumption and waste water generation, and the construction of a natural gas power plant.

- Integrate downstream to capture value added: Molycorp has already signed a number of non-binding letters of intent variably to acquire a third-party producer of rare earth metals and alloys in the US, to form a joint venture to produce NdFeB magnets in the US, and to undertake a technology transfer agreement with Canadian-based Neo Material Technologies with respect to the production of rare earth metals, alloys and magnets. If successfully implemented Molycorp would become the first fully integrated supplier of NdFeB magnets in the world, and the only producer of NdFeB magnets in the United States.

- Develop new higher margin products particularly for rare earths which have historically had lower demand: For example Molycorp has already developed XSORBX a cerium-based product which removes arsenic and other heavy metals from industrial processing.

- Continue exploration at Mountain Pass: in order to upgrade existing resources and investigate unexplored areas.

Molycorp may be assisted in achieving its plans by the experience of its employees, many of whom worked at the Mountain Pass facility for more than 20 years each. The CEO has 24 years' association with the facility. Molycorp's
initial target is to produce 19,050 tonnes of rare earth oxide per annum, though it should have the capacity to expand though technology improvements to 40,000 tpa if market conditions prove favourable.

Arafura Resources (ASX: ARU, Market Capitalization: AUD$375 million)

Arafura Resources is developing the Nolans rare earths/phosphate/uranium project in Australia. The project, which has the potential to be low cost and high recovery, is currently at the Bankable Feasibility Study stage and on target to begin production in 2013. It will comprise an open pit mine at Nolans Bore in the Northern Territory and a processing plant at Whyalla on the South Australian coast which will produce rare earth oxides, phosphoric acid, gypsum and small quantities of uranium oxide.

Nolans Bore is a world class deposit. Exposed at surface it has a JORC resource estimate of 30.3 million tonnes, at a grade of 2.8% rare earth oxide, 12.9% phosphorus pentoxide (P2O5) and 0.44 lbs/tonne of uranium oxide (U3O8), equivalent to an in situ resource of 848,000 tonnes of rare earths, 3.9 million tonnes of phosphorus pentoxide and 13.3 million pounds of uranium oxide. The mix of rare earths includes a relatively high proportion of neodymium; the average price of the Nolans Rare Earth mix is currently $51/kg.

The deposit, which covers an area roughly two by two kilometres, is located 5km from a gas pipeline, 10km west of the Stuart Highway, (the principal north-south route through Central Australia), and 135km from Alice Springs. Ore from the open pit will be transferred to an on-site beneficiation plant for upgrading to a concentrate. It will then be trucked 65km by private road to a rail siding on the Darwin-Adelaide railway and thence taken 1400km by rail to the Rare Earths processing and separation complex to be built at Whyalla. The process flow sheets for the complex have already been extensively tested and refined at the ANSTO (Australian Nuclear Science and Technology Organisation) facility in Sydney; recovery rates are now expected to be high.

Whyalla was recently announced as the chosen site following a two and a half year site selection survey. It was picked as it is a brownfield site, has good access to a skilled labour force, is well serviced by road, rail and port facilities, the seawater can be used for a desalination plant, and as the community and State Government are supportive; the South Australian government has recently announced that it will declare the Complex a 'major project', thus according it the same status as BHP Billiton's Olympic Dam project.

The economics of the project look favourable. Although the initial capital cost may be in the order of A$750M operating costs will be relatively low, recovery rates should be high and there will be significant by-product credits. At current commodity prices Arafura could generate more than A$1B in revenue each year with a mine life of at least 20 years, more if the current drilling programme is successful in expanding the resource.

Arafura's priorities in the short to medium term are to complete the bankable feasibility study, to finalise the processing technology, to continue the drilling programme to increase the resource base/reduce risk, to gain the necessary approvals and to seek appropriate financing and marketing arrangements. Construction is scheduled to begin in 2012 with production beginning in the second half of 2013.

Arafura owns five other exploration projects for various commodities in the Northern Territory ranging from early to advanced exploration stage. It is seeking to joint venture all the non-REE projects.

Avalon Rare Metals Inc (TSX:AVL, Market Capitalization: CAD$270 million)

Toronto-based Avalon Rare Metals is currently developing a number of rare metals projects in Canada. Its flagship project, the 100%-owned Thor Lake project in Canada's Northwest Territories hosts the Nechalacho deposit, which is the second-largest rare earth element deposit in the world by reported total rare earth elements, and the third largest niobium deposit. Besides being large the deposit is also high grade with an exceptionally high enrichment of valuable heavy rare earth elements (more than 20% in the Basal Zone) which should generate high operating margins. The project is located 100km south west of Yellowknife; access is currently by air but there will be summer access by barge across the Great Slave Lake to a railhead and ice road access in winter.
Avalon has invested in a five-year $25M exploration program to date culminating in the publication of the pre-feasibility study in June 2010. The study confirmed the very positive economics for the project despite its remote location anticipating a base case after tax IRR of 12% and an NPV of $560M at 5% or $236M at 8%. Under more positive assumptions the IRR could rise to 33% and the NPV at 8% to $1.4BN.

The recommended plan was to construct an underground room and pillar mine with an expected life of 18 years processing 2000 tonnes per day of ore (lower at start up) to produce 10,000 tpa of mixed REO oxides which could be processed elsewhere. Operating costs are anticipated to average $267/tonne. The total capital cost is expected to be $900M (allowing for a 22% contingency) and production is expected to start in 2015.

The company thus offers a number of competitive advantages including:

- Development stage and first mover advantage; The project is already 5 years down a 10 year development scale and could be one of the early new projects to reach production after Lynas and Molycorp.
- The metallurgy has been determined: and shown to have no deleterious contaminants and to exhibit good recoveries of around 75%. Moreover there should be significant by-product revenues from zirconium, niobium and tantalum.
- The pre-feasibility study is "in the bag": enabling Avalon to begin offtake discussions with potential customers and for customers to know that the there is no risk of running out of resources.
- It is located in a politically stable jurisdiction
- The management team has considerable expertise in the sector and Avalon has strong relations with the local First Nations communities; 40% of employment at the site is aboriginal. It adheres to a strong corporate ethics and CSR policy.
- There is considerable potential to increase the resource
- The company has no debt and $8m in the treasury.

Avalon’s other projects include the Separation Rapids lithium project, the Lilypads tantalum project and the Warren Township calcium feldspar project all in Ontario though Warren Township is currently inactive pending resolution of a permitting issue. It also owns the East Kemptville tin-indium-gallium-germanium in Nova Scotia where large inferred resources have been identified though further drilling will be required to bring the project to the pre-feasibility stage.

**Rare Element Resources (TSX.V:RES, Market Capitalization: CAD$233 million)**

Rare Element Resources was listed as one of the Top 50 companies on the Toronto Venture Exchange in 2010. Its flagship property is Bear Lodge which lies 12 miles from Sundance in Wyoming, USA. The 2100 acre property hosts one of the largest rare earth deposits in North America plus extensive gold mineralisation, both lower grade at surface and higher grade at depth. The local infrastructure is good with paved road and power within 2 miles and a railhead 35 miles away.

The company published an updated NI43-101 inferred resource on the rare earth deposit in May 2010 of 17.5M tons at 3.46% REO (including 4.4 mm tons at 6.65% REO). The total contained rare earth oxide is thus 1.2B lbs. Cerium, lanthanum and neodymium were the most prevalent of the rare earth elements. The estimates were based on 48 holes drilled at two deposits on the property. There is significant upside potential for expansion at both deposits.

In August the company announced further progress towards a commercial metallurgical process. It is now possible to produce a pre-concentrate at 90% recovery containing up to 20% rare earth oxide from the oxide deposits on the property. Further drilling to define reserves and expand the deposits and a scoping study are now underway. If the study sufficiently positive the company plans to initiate mine permitting and a prefeasibility study.

**Quest Rare Minerals (TSX-V:QRM, Market Capitalization: CAD$179 million)**

Quest Rare Minerals has enjoyed a number of exploration successes since listing on the Toronto Venture Exchange in January 2008. It was the best performing share on the exchange in 2009 rising more than 5000% from 5 cents to $3.38. It is now advancing two rare earth projects in Quebec.
Quest discovered the B zone deposit at its flagship project, Strange Lake, in 2009 publishing an NI43-101 compliant inferred resource in April this year and a Preliminary Economic Assessment on the project in early September. Key points are:

• The project is located in NE Quebec some 125 km west from the coast and the huge nickel mine at Voisey's Bay. The deposit is a very large surface deposit, one of only two known heavy rare earth deposits in the world, (the other being Avalon's Nechalacho). It has considerable upside potential remaining open in all directions and at depth. The inferred resource is 40.4 million tonnes grading 1.161% TREO (of which 47% are heavy rare earths), 2.07% zirconium oxide, 0.25% niobium oxide (Nb2O5) and 0.053% hafnium oxide (HfO2).

• The PEA indicated a strong IRR of 36.4% and an NPV at 8% of $2.4B pre-tax and pre-finance. The mine model calls for an open-pit production rate of 4,000 tonnes per day, requiring a capital expenditure (CAPEX) of $563.4 million (including a 25% contingency), a payback in the fourth year of production and a minimum mine life of 25 years.

**Greenland Minerals and Energy (ASX:GGG, Market Capitalization: AUD$147 million)**

Perth-based Greenland Minerals and Energy is exploring and developing the giant multi-element rare earths/uranium/sodium fluoride Kvanefjeld Project. This is located on deep fjords which run directly to the North Atlantic Ocean some 8km from the port of Narsaq on the southern tip of Greenland. The company has conducted an aggressive exploration programme since acquiring 61% of the project in 2007 (with an option to acquire the remaining 39%). In February 2010 it published an interim report on the pre-feasibility study which indicated that the project has the potential to become a highly profitable world class mine. Certainly the resource is huge, totalling 457M tonnes containing 4.91M tonnes of rare earth oxides, 283M lbs of uranium, 0.99M tonnes of zinc and 3.0M tonnes of sodium fluoride. It is mostly outcropping and lies within 300 metres of the surface.

The mining studies have indicated the potential for a large open pit operation with a low stripping ratio. The highest grades are to be found nearest to the surface and there is significant potential for new multi-element deposits. The capital cost for the mine and processing plant capable of treating 10.8Mtpa is $2.3B. Construction could begin in 2013 and first production in 2015. The projected mine life is over 23 years with the pre-tax NPV estimated at US$2.18N and the ungeared IRR 24%.

Greenland is an emerging mineral province. It is highly prospective, underexplored, politically stable and open to investment. However a key issue for GMEL could be the Greenlandic government stance on uranium exploration which is currently a zero tolerance approach. The company recently received a letter from the government which made clear its support for ongoing work programs and stated that the outcomes of the Company’s feasibility studies will form the basis of a decision on whether to grant an exploitation permit. The company is working closely with local communities on its environmental and social impact assessments.

**Great Western Minerals Group (TSX-V:GWG, Market Capitalization: CAD$78 million)**

Saskatchewan-based Great Western Minerals has a fully integrated rare earths mine to market (M2M) strategy. The company’s aim is to become the first vertically integrated rare earth elements producer in North America, a leader in the industry outside of China, and to create certainty of supply for its customers. To that end the company is investing in three stages in the rare earths supply chain: exploration, mining and processing.

Working backwards down the chain, the company already processes rare earths through two of its subsidiaries; Less Common Metals (LCM) based in Birkenhead, England and Great Western Technologies Inc in Troy, Michigan, USA. LCM has been highly profitable for 18 years supplying customers globally with a wide range of rare earth based alloys and metals. Its specialities include neodymium iron boron and samarium cobalt alloys for supermagnets, supplying 20% of the world demand of samarium cobalt. Great Western Technologies is a leading production facility in North America for rare earth materials, powders, and custom vacuum-grade specialty alloys. Both companies aim to be...
leading-edge, innovative and high quality offering flexible customised approaches to their customers.

Great Western will source its feedstock from the former-producing Steenkampskraal Mine in South Africa, located some 350km north west of Cape Town. The mine was operated by Anglo American from 1952-63 producing both rare earths and thorium (indeed it was then the world's largest producer of thorium). It was eventually acquired by Rare Earth Extraction Co ("Rareco"), and in January 2009 GWT entered into an option agreement with Rareco to refurbish and recommission the mine and to have exclusive access to 100% of the rare earth elements mined there for a ten-year period. The New Order Mining Right was granted in June 2010, and in September 2010 GWT acquired a 20.8% equity interest in Rareco.

SRK Consulting has been engaged to conduct a feasibility study on the project with the aim of resuming production as quickly as possible; the target is the second half of 2013. Infrastructure is excellent, with access to the site by paved and gravel roads and close proximity to rail and sea-port; the governments are pro-development, and there is technical expertise at hand as well as a trainable work force.

GWMG is also looking to the long term by investing in 7 exploration projects. Four of these are 100% owned (with 2 in Saskatchewan, and one each in Utah and New Brunswick) while three are joint ventures, in Yukon, Labrador and New Brunswick. All are focussed to the heavy rare earths.

**Commerce Resources (TSX-V:CCE, Market Capitalization: CAD$68 million)**

Commerce Resources owns three projects in Canada. The Blue River tantalum/niobium project in British Columbia is the most advanced; an updated resource estimate for the Upper Fir deposit at the project estimates the deposit to contain an indicated and inferred resource of 23.9Mt containing 11.2M lbs of tantalum pentoxide and 64M lbs of niobium pentoxide. A Preliminary Economic Assessment is underway scheduled for publication in the fourth quarter of 2010. Commerce is also involved in a JV in British Columbia on the early stage Carbo rare earths and niobium project whereby Canadian International Minerals has the option to acquire up to 75% subject to certain payments, expenditures and a 2% NSR royalty. A drilling programme has just begun on site.

In northern Quebec the company has 100% ownership of the Eldor Property which hosts the Eldor Carbonatite. Carbonatites are relatively rare rock types which contain a variety of exotic minerals, and can produce economic concentrations of rare earth elements, niobium, copper, iron,apatite, vermiculite and fluorite; with significant by-products which may include barite, zircon, tantalum, gold, silver, uranium, nickel and platinum group elements.

Commerce discovered the Ashram Rare Earth Zone in 2009 in the centre of the carbonatite complex by tracing the source of a glacially dispersed boulder train that assayed significant rare earth elements (REE). Initial sampling from outcrops and trench sampling returned high values (up to 2.74%) of rare earth element. Drilling began in summer 2010 and results from the first two holes showing broad thickness (the second hole included 1.95% TREO over 243.8 metres) and relative continuity of grade have confirmed the potential large tonnage rare earth discovery. The four most abundant REEs in the deposit are cerium, lanthanum, neodymium, and praseodymium. At the end of April 2010 the company had $19M in cash and investments.

**Medallion Resources (TSX-V: MDL, Market Capitalization: CAD$9 million)**

Medallion Resources' aim is to position itself through acquisitions and the application of advanced exploration techniques at the forefront of the REE exploration industry in North America. Its strategy is to acquire projects which are skewed towards the heavy rare earths and are amenable to large-tonnage open-pit production. Medallion is currently involved in two projects.

Firstly it has an option with Rare Earth Resources to earn up to 65% on the Eden REE project in Manitoba through payments of $1.45M cash and 1.8M shares, and expenditures of $2.25M over 5 years. Medallion was attracted to the project as it believes that it could be one of the most promising REE projects in North America with a large mineralized area (7–8 square km), high REE values, the potential for a large surface deposit and four different styles of REE
Medallion was also attracted by the location; it is one of only a few REE properties in Canada within practical distance of roads, power & mining-service centres. The town of Leaf Rapids is just 20km away. Moreover the property is not expected to present significant permitting, environmental or social challenges. The first phase of the 2010 program aimed to identify the promising areas of mineralisation through mapping, sampling and field checking historic data. The company are now conducting a channel sampling exercise on the rock deemed to have the best potential for cost effective mining.

Medallion's second project is the Red Wine HREE Project located in southern Labrador, Canada where Medallion has an option to earn 100% through a series of payments in cash, shares and exploration commitments. Medallion believes that it has the opportunity to make a significant discovery at Red Wine, as there has been no detailed REE exploration in the area though the unusual nature of the intrusions and their REE concentrations were discovered during the search for uranium about 50 years ago. Since then, the area has been prospected for niobium, tantalum, beryllium and zircon. The REE's were always noted but drew little interest. Medallion's holdings at Red Wine were believed to host eudialyte, an important HREE-bearing mineral. Initial exploration work by Medallion has confirmed the previous mapping of the eudialyte.
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