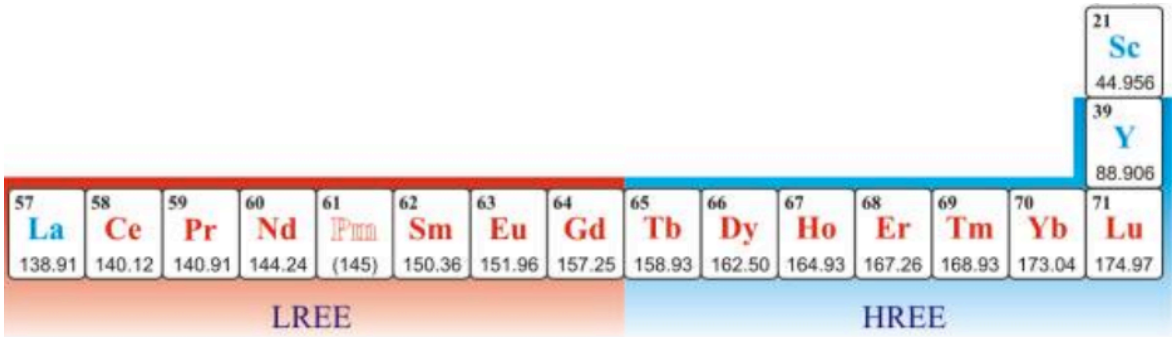
Defense Metals Wicheeda deposit could break Chinese rare earths monopoly

A rare earths deposit in British Columbia has the potential to lessen or break China's monopoly on the 17 elements in the periodic table used in a host of industrial and military applications.



The Wicheeda Light Rare Earth Element (LREE) project near Prince George hosts three of five rare earth elements that were highlighted in a Canadian government report due to their "scarcity, high demand, and criticality in much high-tech application": neodymium (Nd), europium (Eu) and dysprosium (Dy).

The other two REEs mentioned in the report were terbium (Tb) and yttrium (Y).

Neodymium is a component of permanent magnets used in motors or generators, such as electric vehicles and wind turbines. Europium phosphors dramatically improved the picture quality of early CRT televisions by introducing the color red, and they are used in LED lights. Dysprosium is mainly used in alloys for neodymium-based magnets, because it is resistant to demagnetization at high temperatures. A ceramic-metal composite containing dysprosium is also used in nuclear reactor control rods.

Both the Canadian and US governments have signaled their interest in developing this vital sector of the high-tech economy that few people appreciate or understand.

The following are key points from the 2014 parliamentary report:

- Canadian industry is looking to secure 20% of global REE supply.
- REEs support a manufacturing sector worth between $2 trillion and $4.8 trillion.
- The world consumption of REEs is increasing at 8-12% per annum.
- Industrial demand for rare earth elements is projected to climb by as much as 2,600% by 2025 according to a study by MIT.

The United States is keen to regain the advantage in rare earths it lost to the Chinese at the end of the millennium.

The 2019 National Defense Authorization Act prohibits the Department of Defense from acquiring rare earth magnets – along with certain tungsten, tantalum and molybdenum products – from China, Russia, Iran and North Korea.

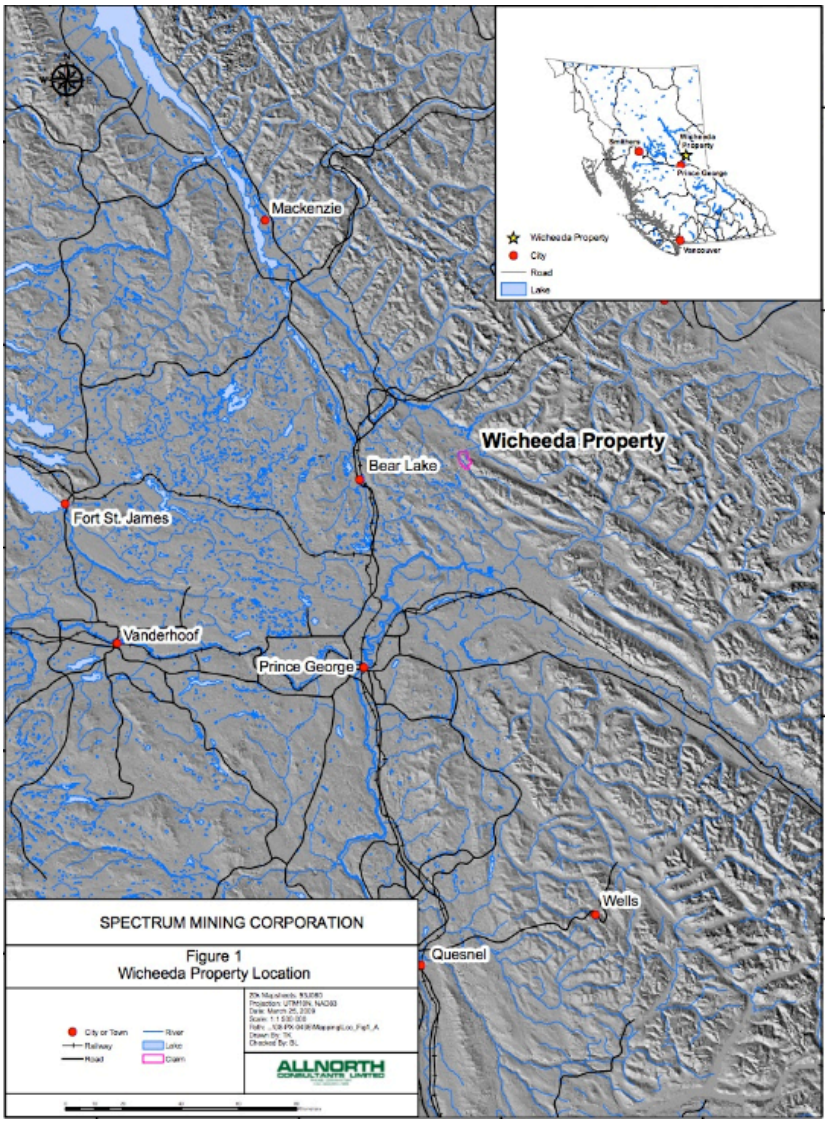
Currently the only non-Chinese mining of rare earths occurs in Australia and the United States. Lynas Corp mines REEs from its Mount Weld mine in Australia and processes them in Malaysia. The only US rare earths mine, Mountain Pass in California, was recently restarted from bankruptcy, but the mined material is sent to China for processing.

In 2017 President Donald Trump signed an executive order calling on the government to reduce foreign reliance on critical minerals, including rare earths, as well as a variety of others like cobalt, tin, lithium and titanium. The EO directs the Interior Secretary to identify new sources of critical minerals on US soil and to streamline the "leasing and permitting process to expedite production, reprocessing and recycling of minerals at all levels of the supply chain."
"The United States must not remain reliant on foreign competitors like Russia and China for the critical minerals needed to keep our economy strong and our country safe," Trump said at the time.

The order came a day after the US Geological Survey published the first assessment of the country's critical mineral resources since 1973. It found that 20 of 23 critical minerals the nation relies on, are sourced from China.

While there is prospective ground for rare earths in Alaska and Wyoming, for example, there are currently no US rare earth deposits even close to production. One of the most promising is the Wicheeda light rare earths deposit (LREE) in British Columbia, being developed by Defense Metals Corp. (TSX-V:DEFN).

Wicheeda



Located 80 kilometers northeast of Prince George, the Wicheeda property is made up of six contiguous claims covering 1,706 hectares.

Vancouver-based Defense Metals signed an option agreement with Spectrum Mining on January 8th 2019 for its Wicheeda claims.

Spectrum explored the property in the late 2000's and put out an NI 43-101-compliant resource estimate.

REE-enriched carbonatites are part of an elongated, intrusive carbonatite-syenite complex that extends southward from the west side of Wicheeda Lake for approximately 13km.

The rare earth minerals bastnasite and monazite, containing the REEs, are disseminated fairly uniformly throughout the property.

Spectrum completed the first-ever drill program at Wicheeda in 2008, punching four helicopter-supported diamond drill holes to test the main zone carbonatite for rare earths mineralization.

A further 10 drill holes into the main zone in 2009 returned encouraging values of cerium (Ce), lanthanum (La), neodymium and praseodymium (Pr).

Using the 2008 and 2009 drill results, Spectrum identified the main zone as containing 11.26 million tonnes of a non-compliant 43-101 inferred resources grading 1.16% Ce, 0.54% La, 0.24% Nd and 0.01% Sm (samarium) (2.2% total rare earth oxides) at a cut-off grade of 1% combined Ce+La+Nd+Sm (1.14% total rare earth oxides). The deposit is open for expansion in several directions.

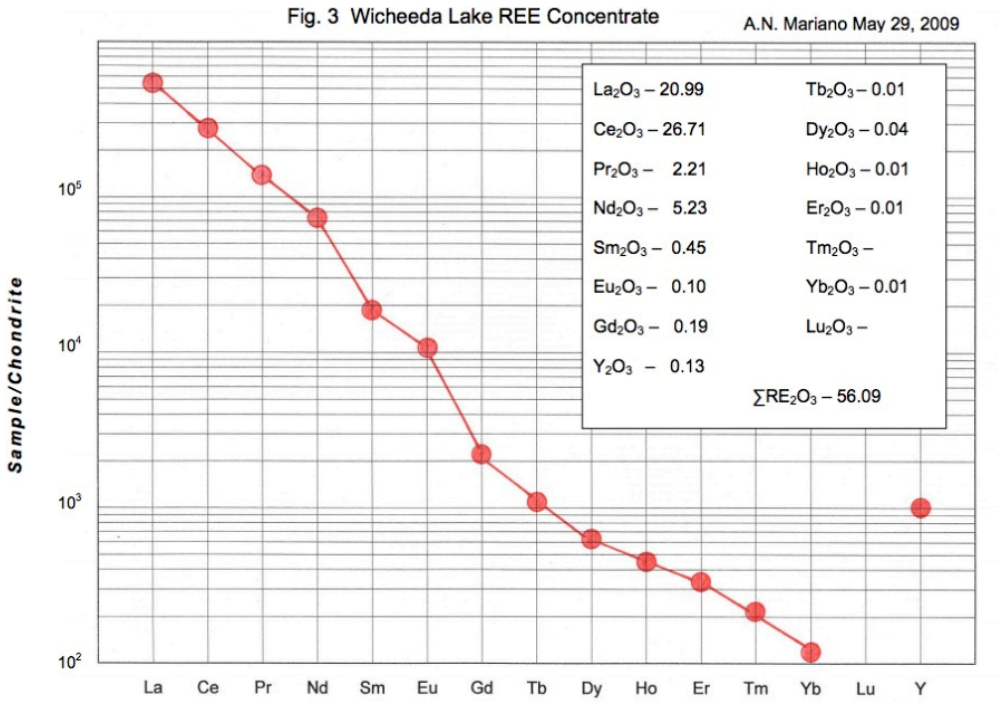
Cutoff (LREE %)	Tonnes > Cutoff (tonnes)	Grade > Cutoff					
		Ce (%)	La (%)	Nd (%)	Nb (%)	Sm (%)	LREE (%)
1.00	11,260,000	1.16	0.54	0.24	0.03	0.01	1.95
1.50	8,670,000	1.30	0.60	0.26	0.03	0.01	2.15
2.00	5,270,000	1.46	0.65	0.29	0.02	0.01	2.40
2.50	1,600,000	1.73	0.73	0.32	0.02	0.01	2.79
3.00	260,000	2.03	0.81	0.36	0.02	0.01	3.20
3.50	10,000	2.44	0.99	0.39	0.02	0.01	3.82
4.00	1,000	2.86	1.22	0.40	0.01	0.01	4.48

During a 2010 exploration program, 977 soil samples were collected 50 meters apart over 5.5 square kilometers. Soil sample values of 17 elements including cerium, lanthanum, yttrium, niobium, thorium, molybdenum, lead, barium, phosphorous, strontium, iron, manganese, magnesium, calcium, potassium, sodium and zirconium were plotted on topographical maps.

A study was also done to discover the feasibility of making a rare earth concentrate from a composite rock sample taken from Wicheeda carbonatite,

based on three assay samples.

Bench-scale testing yielded more potentially recoverable rare earth elements than the resource estimate's current REEs (lanthanum, cerium, neodymium and samarium) such as dysprosium, europium and praseodymium.



"The result of the mineral concentration made on the Wicheeda sample is very encouraging," wrote study author Anthony Mariano, PhD, a consulting minerals exploration geologist. Mariano noted he's only seen a high-grade REE concentrate similar to the Wicheeda composite in China - where around 90% of the world's rare earths are mined and processed.

"If exploration at Wicheeda can substantiate a sufficient quantity of grade and tonnage of material similar to this it will be a very attractive potential source of LREE [light rare earth elements] to the market place," he wrote.

Bench-scale flotation and hydrometallurgical testwork was done on Wicheeda drill cores at an SGS Lakefield lab during 2010-11. SGS successfully developed a flotation flow sheet that recovered 83% of the rare earth oxide (REO) and produced a concentrate grading 42% REO.

Subsequent hydrometallurgical testing in 2012 on a two-kilogram sample of the concentrate grading 39.7% total rare earth oxide (TREO) produced an upgraded and purified precipitate that contained 71% TREO through a process of pre-leaching and roasting.

Returning to the line graph above, notice that Tony Mariano in his report identified 15 rare earth elements from three assay samples taken from the Wicheeda carbonatite. Three of these REES are noteworthy for their "clean energy" credentials, along with their other industrial uses.

Cerium

Named after the Roman god of agriculture, cerium is the most abundant of the lanthanides, a group of 15 rare earth elements with atomic numbers 57 through 71.

The "rare" in rare earth elements came from frustrated 19th century chemists who decided they were uncommon after trying to isolate these chemically related elements. REES are also very hard to find in economic concentrations.

Overall, REEs are more abundant in the Earth's crust than silver, and are found in amounts similar to copper and lead.

One of the most important uses of cerium is in catalytic converters. Previously, engines ran either rich (excess fuel) or lean (excess air). The small fluctuations made for inefficient engine performance.

In the 1980s a device was invented that could combine all three catalyst functions into one. The three-way catalyst (TWC) is now the mainstay of vehicle emissions control.

Adding cerium oxide to the TWC means it is now possible to run a gasoline engine with the exact mixture of air to fuel. The TWC reduces harmful nitrogen oxides to

nitrogen and oxygen, oxidizes carbon monoxide to carbon dioxide, and oxidizes unburnt hydrocarbons to carbon dioxide and water.

The average auto catalyst contains 20 to 30 grams Ce per cubic liter.

Cerium is also used as a polishing media, in flints for cigarette lighters, inside ovens to prevent build-up of cooking residues, and in flat-screen TVs, light bulbs and floodlights.

Lanthanum

Lanthanum is a key ingredient in hybrid vehicle batteries. The second-most abundant REE is the "metal" in the nickel-metal-hydride battery found in every Toyota Prius - about 10 pounds worth.

NiMH rechargeable batteries are said to be twice as efficient as the standard lead-acid car battery.

A lesser-known application of lanthanum is for oil refining. Fluid catalytic cracking (FCC) catalysts employ lanthanum and cerium to convert crude oil into value-added products like gasoline. These two REEs substantially increase the activity and stability of zeolites, commonly used as adsorbents and catalysts.

This use of lanthanum has good potential for DEFN, considering that Alberta is looking at building new oil refining capacity. Premier Rachel Notley announced in December the provincial government is asking for expressions of interest from the private sector to build a refinery that would use Alberta crude oil.

New refining capacity would be a solution to the current oil glut in Alberta that has come about due to lack of pipeline capacity, which in turn causes Canadian Western Select oil to trade at a significant discount to WTI, the North American benchmark.

A new refinery is already running near Edmonton, but is not yet using oilsands bitumen as a feedstock to produce diesel. The $9.7 billion facility, the first refinery to be built in Alberta in 30 years, is a joint venture between North West Refining and Canadian Natural Resources Ltd.

The refinery has been producing diesel from synthetic crude upgraded at an Alberta oilsands mine for about a year. The part of the project that will upgrade bitumen has been delayed due to equipment failures. However once the kinks have been ironed out, the North West Sturgeon Refinery is expected to process 50,000 barrels per day of bitumen and return 30,000 bpd of diluent to the Alberta market.

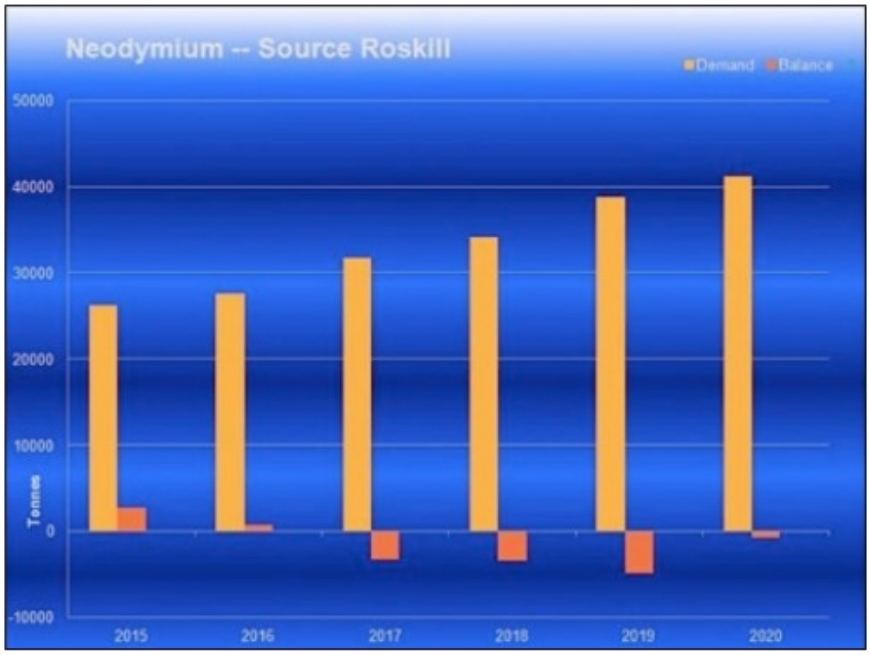
The North West Sturgeon Refinery and other new oil refineries in Alberta will require tonnes of lanthanum for the upgrading process. Lanthanum processed on site at Bear Lake could be trucked to Edmonton within seven hours.

Neodymium

Neodymium and praseodymium are used in permanent magnets, found in electric vehicles and hard disk drives, for example. Dysprosium is added to neodymium-iron-boron magnets in high-heat applications.

The Nd is alloyed with iron and boron to make a strong permanent magnet. The discovery of neodymium magnets in 1983 allowed for the miniaturization of electronics, paving the way for our modern mobile devices. Neodymium is also used in microphones, loudspeakers, windshield wipers, wind turbines, in laser pointers, laser eye surgery and for treating skin cancer. Everything from hard drives to headphones require a small amount of neodymium.

The market for neodymium magnets is estimated at $11.3 billion. Demand for neodymium, therefore, has been growing steadily.



Samarium

Samarium cobalt magnets were the first rare earth magnets available, in the 1970s. SmCo magnets aren't as powerful as neodymium magnets, but their advantage is they resist corrosion and can operate at high temperatures. They

can also be used in temperatures as low as -273 degrees C (absolute zero). Generators, sensors, motors, pump couplings, and marine applications are some of the places to find samarium cobalt magnets.

Three-step strategy

Step 1: Bulk sample metallurgical testing/ re-assaying the pulps

Defense Metals has sent a 30-tonne bulk sample to SGS Canada Inc.'s Lakefield, Ont., metallurgical facility in anticipation of a multiphase program of bench-scale metallurgical test work in preparation for commissioning larger-scale flotation pilot plant testing.

"The goal of the Phase 1 A testwork is to develop a robust flow sheet for producing high grade REE flotation concentrates from a 200 kg sample of the 30 tonne Wicheeda REE deposit bulk sample. It is anticipated that 20 kg of REE concentrate will be produced by Phase 1A," says technical advisor Chris Graf.

Following a successful Phase 1A, Phase 1 B hydrometallugical testwork is to commence on the 20 kg sample of flotation concentrate once it has been produced, by the end of May. The goal of this hydrometallurgical testwork will be to produce a purified, mixed REE concentrate and provide data that can be used to design a hydrometallugical pilot plant.

The Phase 1 A flow sheet will be used in a Phase 2 flotation concentrate pilot plant program where the entire 30 tonne Wicheeda bulk sample will be processed with the goal of demonstrating that the Phase 1 A flowsheet is capable of producing a high grade REE concentrate on a semi commercial scale. It is expected that the Phase 2 pilot plant metallurgical testwork will produce approximately 3 tonnes of REE concentrate that can be tested by a Phase 3 hydrometallurgical pilot plant.

The metallurgical testwork is expected to be completed by May 20.

Read the Feb. 25 press release

Step 2: Pilot plant

The next step is to build a 200-tonne-per-day pilot plant on a dormant sawmill site at Bear Lake a short 40 minute drive north of Prince George on Highway 97.

Mining would be an open pit scenario, basically just an earth moving operation with a zero strip ratio. The raw ore would be run through a magnetic separator – bastnasite and monazite are magnetic – and the resulting early-stage concentrate would be trucked to DEFN's pilot plant in Bear lake for further beneficiation. Production, under a BC Small Mine Permit, would gradually be scaled up. The idea is to produce rare earth concentrate that would be sold to end users. Defense Metals could also use its scaled-up processing plant to contract process other companies' rare earths. A CN rail line runs past the old sawmill site.

The Bear Lake site has adequate power, water, a railway siding and a nearby natural gas pipeline - all the elements needed for rare earth processing and shipping.

The environmental impacts are expected to be low - no uranium, low levels of thorium, and radiation well within British Columbia's strict guidelines. Prince George has many industries currently using chemicals such as caustic soda and hydrochloric acid, and by-products of operations range from white/black liquor to lime and others. There is a trained workforce already very familiar with the shipping/receiving, use of, and proper disposal of chemicals, being home to a methanex plant and three pulp mills.

Step 3: Hydrometallurgical plant

The last step, and Defense Metals' ultimate goal, is to build a hydrometallurgical plant at Bear Lake that would convert rare earth concentrate into individual rare earth oxides, for sale to specific end users. Customers could include military defense contractors, considering the high concentration of metals used for

defense purposes, and companies in the magnet manufacturing sector, which require combinations of neodymium, praseodymium and dysprosium or samarium and cobalt.

Like the concentration processing plant, the hydro-met plant could also do "contract processing" of other REEs from companies that ship their rare earth concentrates, by rail, directly to DEFN's Bear Lake facility.

Currently, almost 100% of rare earth processing is done in China, even when the rare earths are mined elsewhere. Imagine being able to cut out the middle man and supply REEs directly to North American manufacturers? A true 'in house' Mine To Magnet story!

Funding is being sought from Canadian and US grant money available for companies that are developing critical minerals' projects.

Conclusion

The Russian military has quietly been increasing its presence in the Arctic. Fighter patrols are to resume for the first time in 30 years, in addition to regular bomber flights to the edge of Canadian and American airspace. The Russians have also opened up a new gas field on their central coast and control of the Northern Sea Route has reportedly been given to a central government agency.

In Venezuela, Russia is moving in on the US's backyard by supporting President Maduro and his government militarily and economically. The South American nation owes the Kremlin billions worth of money and oil, so Russia has a stake in keeping Maduro in power so that the debts are paid.

Top Russian oil producer Rosneft also wants a piece of the Orinoco, the largest oil reserves in the world controlled by PdVSA, Venezuela's state-owned oil company.

Venezuela is an important ally because it is the last Russian foothold in Latin America after all the other countries embraced capitalism in one form or another.

Russia has supplied Venezuela with $4 billion worth of weapons since 2005 including 50 helicopters, 24 fighter jets and 100,000 Kalashnikov rifles, the Globe and Mail said. In fact a Kalashnikov factory is slated to open there at the end of the year. In December Russian bombers landed in Caracas in support of Maduro's regime, a Russian passenger plane flew there with the intention to fly out 20 tons of gold, and 400 mercenaries have been dispatched to protect Maduro.

US interests in Latin America and Canadian/ American Arctic sovereignty are under threat by increasing belligerent Russia and China. China is continually flexing its muscles in the South China Sea, an area it claims as its own territory, and the US is fighting a trade war with China that has yet to be solved and could escalate into a military confrontation.

Meanwhile, we have Russian engines being deployed on US rockets, and magnets made from Chinese rare earths are used in the Joint Strike Fighter, the Pentagon's answer to a one-size-fits-all warplane. There is no Mine to Magnet rare earths chain in the US – the Mountain Pass mine processes the REEs in China and there are no deposits close to production.

Defense Metals has a rare opportunity to move the Wicheeda rare earths deposit forward into a mine that not only has the potential to supply the US and Canadian militaries, but to mine rare earths for a number of important civilian uses.

Cerium, lanthanum, neodymium, praseodymium, samarium and europium are among the REEs that have been identified in previous bench-scale testing. Applications for these rare earth elements include cerium in catalytic converters - electric vehicles are growing in popularity but gas and diesel aren't done yet; lanthanum in hybrid vehicles and new oil refineries that Alberta is looking at building; neodymium and praseodymium in permanent magnets; and samarium in sensors, generators and motors, for example.

As DEFN progresses its Wicheeda project, the company will have no shortage of

customers lining up for offtake agreements, nor suitors ready to make an acquisition once the elements in the ground and the metallurgy have been proven out.