

Vital Metals aims to become the lowest cost producer of mixed rare earths oxide outside of China

Demand for secure supply of rare earths grows with technology and electric vehicles

We have known about this "problem" for more than 20 years. You don't have to be sinophobic, but if you are a manufacturer who relies on the sourcing of Rare Earth Elements (REEs) for your manufacturing outputs, maybe you should be. China still counts for about 80% of the world's REE production. They have dominated the world of rare earths since the late 1990s, but growing reliance on technology requires more and more of the somewhat obscure but necessary REE minerals to create our electronic gadgets and increasingly, electric vehicle and accessory components.

Enter Vital Metals Limited, (VML: ASX) an Australian listed global explorer of rare earths. While their initial impact may be small in the future supply-chain for REEs, they are an important part of the global movement for the diversification of REE production from a concentrated source – think eliminating the OPEC dominance of oil production 50 years ago and how the world succeeded (mostly) with that.

OK – what is a rare earth element and why are they important? There are technically 15 REEs, although two others are generally included as they have similar characteristics. They are further broken down into "light" REEs that are produced globally (and are in abundance) and "heavy" REEs that are

produced mostly in China and are in limited supply. Heavy REEs are in demand for their usage in high technology and clean-energy applications. The US military is buying these from China to manufacture – among other things – their armored vehicles, precision-guided weapons, batteries and night vision goggles. China is not the enemy, but at the very least the global supplier is not considered a “friendly”.

REEs are mined. Mining of these elements is usually in remote and not-so-hospitable locations. Any region that has REE potential that is close to accessible infrastructure should be on the list of “mines to be developed”.

Vital Metals has two of these projects, one in Canada and one in Africa. Their Nechalachco rare earths project in the Canadian Northwest Territories (NWT) on the edge of Great Slave Lake is scheduled to commence the production of rare earth oxide in the first half of 2021. Everything is on track to meet this production schedule as a result of years of previous work on the project (and expenditures of more than \$100 million), and the design of the project parameters is aimed at early cash flow (and low capital costs) of a production stream that is highly desirable to end users.

On August 22, 2020, Vital Metals announced a binding term sheet for the construction and operation of a rare earth extraction plant to produce a mixed rare earth carbonate product. Significantly, the plant will be located adjacent to the Saskatchewan Research Council’s (SRC) planned separation plant which will be able to convert rare earth carbonate mixes to commercial grade rare earth oxides. Vital’s plant is expected to be operational in Q3-2021 with feedstock from their Nechalachco mining project.

Most people do not know that the SRC has almost a decade of expertise in REEs (associated with uranium mining in Saskatchewan) and recently announced the construction of a rare earth processing facility in Saskatchewan, the first of

its kind in Canada. The SRC facility is expected to be operational in late 2022. It is hard to overestimate the importance of Vital Metals' rare earth extraction plant being built in the neighborhood of the SRC facility.



Source: company presentation

The team at Vital are recognized for their expertise in the global rare earth element arena including all necessary elements of mining, processing, geology and marketing. The devil really is in the details, and Vital's team has a cost and time effective strategy to deliver early production and cash flow. Remote locations require extensive planning and timing is everything as mining and processing equipment can only be delivered and setup during certain weather windows.

The company's market capitalization is only about A\$26 million. They estimate that developing the first mine in northern Canada will require less than A\$20 million total capital cost for their first project (North-T, 100% interest), some of which can be funded by future generated cash flow. There is also significant potential upside in the area for exploration and production expansions, which would likely also be funded by internally generated cash flow. The company has a plan to develop the bigger Tardiff Project by 2024, aiming for a 20 year mine life and leveraging off existing infrastructure as the "next phase" in the area.

Vital Metals' second REE project is in Tanzania, with rail and power infrastructure within approximately 10 km of their 90% owned Wigu Hill Project. Previous owners spent approximately \$10 million and management is of the view that this is a high grade, potential world class resource. This asset has an older NI 43-101 evaluation report attributing to it 3.3 Mt at 2.6% REO.

The global movement away from China as the main source of rare

earth elements has been underway for a number of years. The world always knew that as technology developed REEs would become more and more important, but with the development of electric vehicles in particular it is now becoming increasingly apparent that there is a need for more secure and friendly sources of REEs. Vital Minerals' aim is to become a global player in the production of REEs. Their expertise, projects and potential appear to have put them squarely on this path.

See also video: Interview with Vital Metals' Managing Director Geoff Atkins on their rare earths production and new extraction facility.

Peak Resources CEO on the economics of its rare earths project in Tanzania

March 23, 2018 – “But Tanzania is getting ready to start working the backlog of mining licenses and we get that from the mining minister, the deputy mining minister and the commissioner of mining” – said Rocky Smith, CEO of Peak Resources Ltd. (ASX: PEK), in an interview with InvestorIntel's Peter Clausi.

Peter Clausi: The rare earths are an interesting market right now given the electric vehicle movement. Which rare earths does Peak Resources mine?

Rocky Smith: We mine all of the rare earths, but the primary

rare earths in our operation are going to be NdPr – neodymium-praseodymium. They represent about 23% of our total rare earth composition.

Peter Clausi: What are the other ones?

Rocky Smith: Like most rare earth operations, you get about everything, everything comes. There is 15 rare earth elements. The primaries are always cerium and lanthanum, but you always get all of them. In our case the mids and heavies only represent about 1% of the total so they are really not worth that much to talk about.

Peter Clausi: Cerium is not really a rare earth. It is a rare earth, but it is not that rare. It is about as plentiful as copper.

Rocky Smith: Yes. Well, rare earths are really not that rare in the crust of the earth, but harder to find them in concentrations that you can actually recover them from.

Peter Clausi: The economics of mining. You have two projects underway right now.

Rocky Smith: We have an operation in Tanzania where the resource is. We are looking at starting that up and putting in a concentrator in Tanzania. Then taking the concentrate and moving it to Teesside in the U.K. and putting a refinery in there. We will basically crack the concentrate and then separate the impurities and then separate the rare earths from each other.

Peter Clausi: To my ear it sounds expensive to ship concentrate that far away. Why would you not just build on site?

Rocky Smith: The cost of shipping the reagents to the site would be about five times the cost to ship the concentrate to the reagents. So in this case the availability of a

(inaudible) production and we actually do it as a by-product acid source. That is not available in Tanzania. If you were to try to process everything in Tanzania then you would have to ship five tons of reagents to Tanzania for every ton of concentrate that you would have shipped to the U.K. if you would have done it in the other direction.

Peter Clausi: Yeah, that is not very economic. Speaking of economic, you put out a project update in October of 2017 with some very impressive numbers. I saw pre-tax NPV of \$914 million U.S. dollars.

Rocky Smith: Yes. When we got done with the bankable we started really taking a hard look at the numbers and we noticed that we had some high reagent costs, particularly in the floatation areas in Tanzania. We went back and screened that particular area more diligently. We found that there were some opportunities there. We looked at different reagents that were less expensive, which was good, but we also found that the reagents that we were using actually performed so much better than the one that we had in our BFS that we were able to bring more material through the same size plant. The effect of which was we had about a 15% increase in capacity through the plant, which of course affected the economics.

Peter Clausi: When do you think that plant will be constructed and operational?

Rocky Smith: All the construction is really pending, the permits coming through in Tanzania and the required financial raise, so whenever those happen we will start. That will take us about 15 to 18 months to build both these plants. It's a little bit difficult for me to say exactly when these other two things are going to happen. We're making some progress in Tanzania. It's been since July last year when they changed the mining law. Everyone kind of stopped their process. But Tanzania is getting ready to start working the backlog of mining licenses and we get that from the mining minister, the

deputy mining minister and the commissioner of mining. Everyone is pretty much saying the same thing that they've got to set this commission, once that happens they will start working through this long list of mine projects that are there...to access the complete interview, [click here](#)

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Mad About Madagascar's Mining Potential

With the eclipse of Tanzania as a mining destination the hunt is on for amenable jurisdictions in East Africa. In recent years the rising stars have been Mozambique and to a lesser extent, Madagascar.

The last month saw the full court press of the great and good of Madagascar descend upon London for a day of interaction with London investors in the energy and mining sectors. We attended in the company of NextSource Materials Inc. (TSX: NEXT | OTCQB: NSRC) (formerly Energizer Resources) which has a graphite project and a vanadium deposit in the country.

The event had a certain element of cloak and dagger to it with the location of an event only being released a few days before the event to the hundreds of people attending, somewhat like a house-rave in the 1980s. However in light of the lively politics this century we can see why organisers did not want the event disturbed by the appearance of a rent-a-crowd. As it turned out the event was in the august premises of the Skinners Company (a City Guild).

A Lively Recent Past

The early part of this century was politically colourful in Madagascar after a long period of relative quietude. President Ravalomanana came to power in April 2002 after a hotly contested election. Things were relatively quiet until the end of 2008.

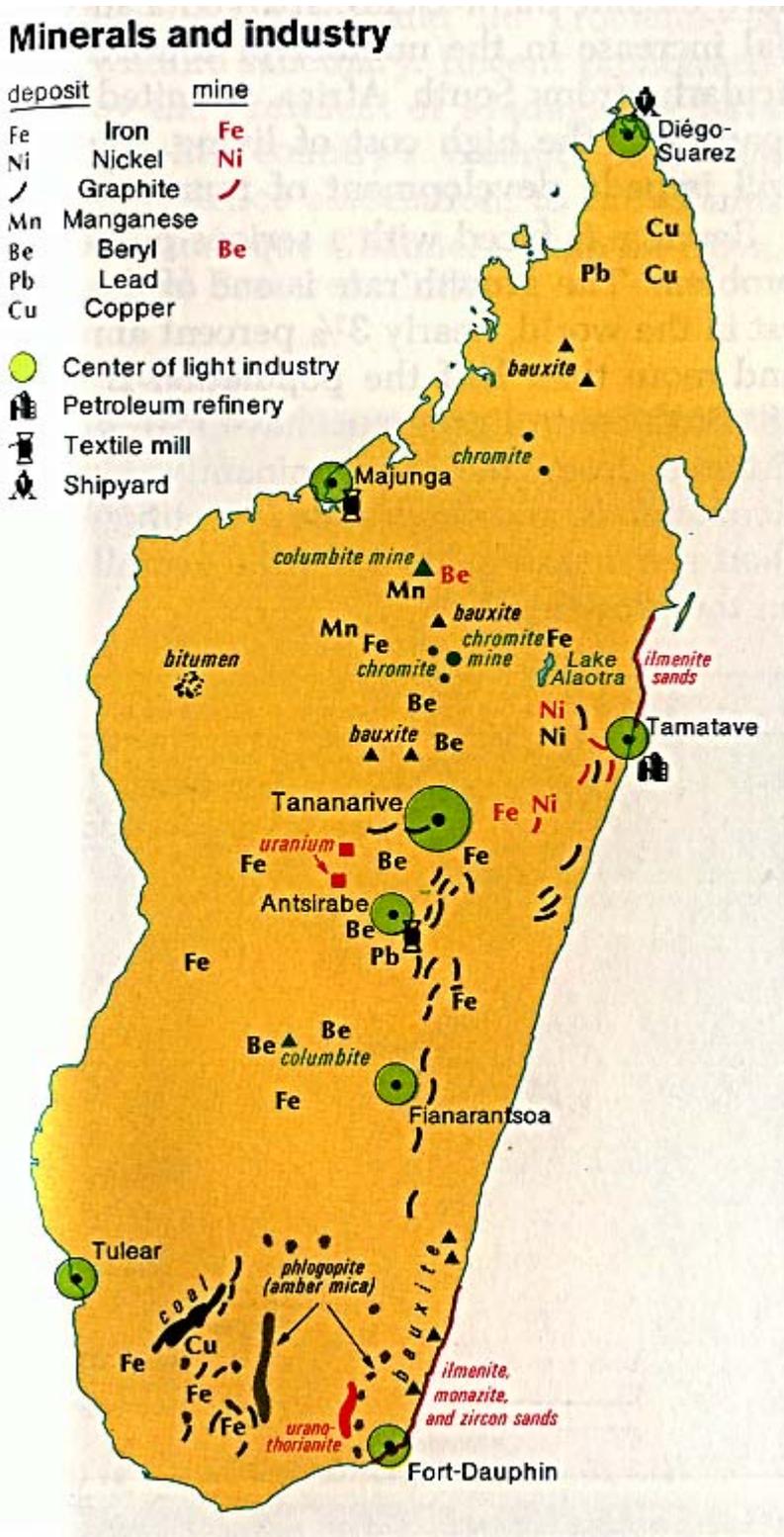
There were riots starting in January of 2009 in the capital that left around 170 dead. After losing support of the military and under intense pressure from the mayor of the capital Andry Rajoelina, Ravalomanana resigned as President on the 17 March 2009. Ravalomanana assigned his powers to a military council loyal to himself. Other parts of the military called the move by Ravalomanana a “ploy” and said that it would support Rajoelina as leader. Rajoelina had already declared himself the new leader a month earlier and assumed the role of acting President. The European Union, amongst other international entities, refused to recognize the new government, due to it being installed by force. The African Union, suspended Madagascar’s membership as long as Rajoelina remained president.

Out of all the schemozzle appeared the current president Hery Rajaonarimampianina who was the main speaker at the London event. He has been President of Madagascar since January 2014. Previously he served as Minister of Finance under Rajoelina, and he was the Rajoelina political movement’s candidate in the 2013 presidential election. He won the vote in a second round, defeating Jean-Louis Robinson, the candidate of Ravalomanana’s party.

Mining

The country has scarcely appeared on the radar screen of most mining investors but there are a few major developments, such as Sherritt’s Ambartovy nickel/cobalt mine and Rio Tinto’s mineral sands mine near Fort-Dauphin at the south-east tip of

Madagascar. QIT Madagascar Minerals, which is 80% owned by Rio Tinto and 20% owned by the Government of Madagascar, is extracting ilmenite and zircon from heavy mineral sands over an area of about 6,000 hectares along the coast over the next 40 years.



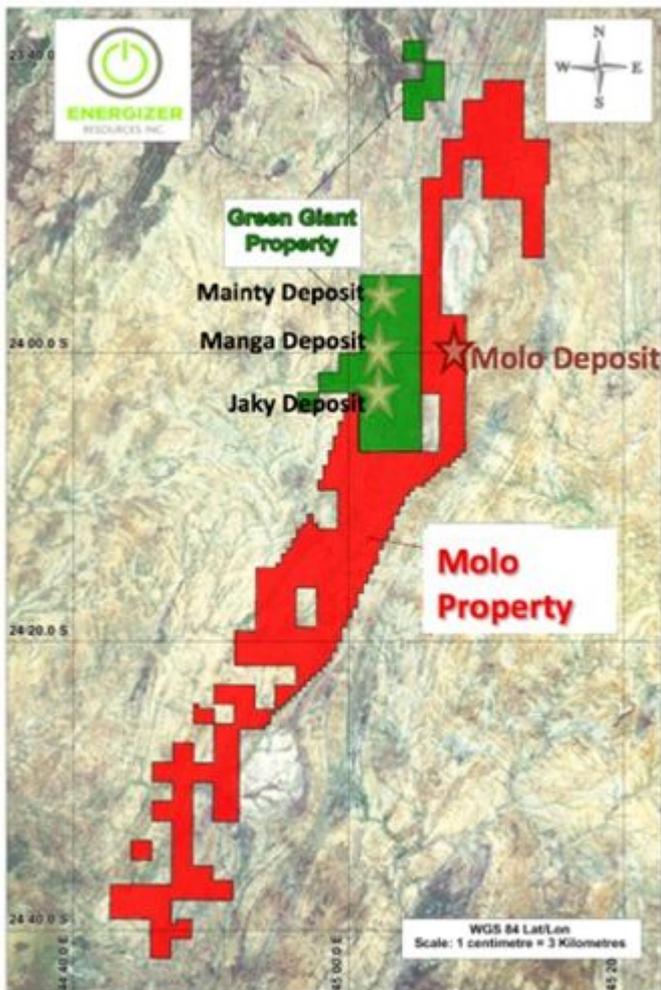
So Madagascar is a country with a number of world-sized mining

projects under way but little else in mining (at least until now). As a result infrastructure is very thin in many parts of the country. The semi-arid south-west corner of the country where the many of the new projects are located is currently infrastructure poor. Thus the move to production will require the upgrading of existing roads, ports, and water supply routes and the importation of diesel power. RTZ set the ball rolling with the construction of the port at Elhoala for its mineral sands exports.

NextSource

Long term denizens of InvestorIntel need little introduction to this company's graphite deposit at Molo but they probably do need reminding of its name change that was precipitated by the need to differentiate itself from a certain infamous bunny. While Molo moves towards production at a swift clip with the project having been reconfigured to a modular, more bite-sized format with a capex at a fraction of previous plans (and almost all competitors) it is easy to forget that the company's original raison d'être. This was the Green Giant Vanadium deposit which shares the same land block as the graphite but is distinct. In fact the "energizing" that was originally foreseen was Vanadium Redox batteries, not the graphite component in Lithium Ion batteries. Now the company can potentially fire on two cylinders (pardon the bad pun) with Vanadium having taken off in recent times because of various reasons.

The map below shows the proximity of the two projects to each other, while also highlighting their divisibility.



Thus investors should not be surprised to get a double energizing from NextSource if it spins out the Vanadium project to have two horses running in the CleanTech/battery technology race. As we may have signaled before we are big fans of demergers to release value for shareholders from disparate themed assets.

Conclusion

While Tanzania did not come up in conversations the undertone was that Madagascar was aiming to wrest for itself the title of the country in East Africa to do mining business. The chief admission from the speakers, both government and non-government was that the processes were slow and that applicants for licenses and permit had to have patience. There was an element of “when in Rome...” fatality about this issue but no-one was really complaining as most had factored it into their timelines.

Importantly no-one said that the processes were arbitrary or irregular in any way.

The clear message though was that the mining potential is enormous and the country sees it as a way of broadening its export revenues from what has been primarily an agricultural export base with a modicum of artisanal (read smuggled) export of gold and gemstones. With massive Nickel/Cobalt exports being joined by minerals sands and hopefully Graphite and Vanadium on a large scale the country seems destined in the next five years to move from being a bit player in global mining to being a substantial force.

Peak positioned to capitalize on explosive EV marketplace over next decade

The electric vehicle (EV) market is beginning to move far quicker than many first anticipated, and the shift is strongly reflected in the associated metals' prices. Lithium and cobalt have been climbing for some time now, but we are finally seeing movement on neodymium / praseodymium (NdPr) oxide; between November 2016 and June 2017, a 32% increase in spot prices has been recorded, prompting Peak Resources Ltd. (ASX: PEK) ("Peak") to push ahead with the permitting stage of their Ngualla rare-earth element (REE) deposit in Tanzania.

This month, Tesla will release their Model 3 vehicle, or at least the first 30 units. Elon Musk has stated that production will be stepped-up throughout the year until the company is producing 20,000 vehicles per month by December. The Model 3 has been reportedly pre-ordered by over 450,000 people so far,

pretty much guaranteeing its initial success and cementing the need for reliable supplies of the component parts. NdPr, being an ideal material for the manufacture of permanent magnets, represents a key ingredient in our cleantech future and is likely to experience a considerable price surge over the next five years as the cultural shift towards new modes of transport reach tipping point.

We've known this was coming for some time, but markets tank and wannabe producers began dropping like flies. Heck, even established big-guys were dragged under by the obstinate downward trend that refused to abate in the face of hype-fuelled overproduction, but we now have a situation in which plenty of material will be required, with very few players left producing them. This is what puts companies such as Peak in a great position looking forward; not only did they survive the bottomed-out metals markets of recent history, but they are in possession of one of the lowest-cost REE deposits in the world thanks to repeated efforts to reduce operating costs.

The team are now in possession of a bankable feasibility study (BFS) and an environmental certificate that will allow them to make progress on the permitting of Ngualla, which is now expected to produce 2,420 tpa of NdPr oxide at greater than 99% purity. Impressively, Peak originally stated that it would cost \$118 million per annum to run the plant in 2014, but this has been reduced to only \$83 million as stated in the BFS, making the project one of the most attractively costed resources currently in existence.

Operating at \$34.20/kg NdPr oxide means that, on an equity financed project, more than \$20 million per annum margin could be achieved on the NdPr oxide product alone, even at today's low spot prices. Further to this, the company identified a significant opportunity to develop a fluorspar product from the same resource, and although NdPr will likely bring in around 90% of the project's income, including the ability to

produce fluoride products alongside REEs will ensure the project is never short of custom.

Peak have proposed off-site processing in Teesside, England, to take advantage of existing advanced processing technologies, solid infrastructure and a skilled workforce. The company aims to coincide the development of Ngualla with the still-recovering value of REEs, but with EV changeover targets being brought forward as far as three years, we could be looking at an explosive marketplace over the next decade, particularly as President Trump continues to take umbrage with materials mined in the far-east. China itself has been ramping up imports of REEs over the last few years, a sure sign that there are a rising number of potential customers waiting at the end of Peak's impeccably-timed launch of Ngualla.

Peak Resources – Prime rare earth mover in 2017

Let's put Peak Resources Ltd. (ASX: PEK) in perspective. There were once hundreds of Rare Earth wannabes. Only two got to production and one of those (indeed the veteran player and most well capitalized and funded) failed. Now there was one, Lynas. It's like an Agatha Christie murder mystery with a very limited field of suspects.

So now there is the second generation on the scene. Though with the caveat that all were around in the first generation, but represent a very whittled down band of survivors. This second generation consists of the companies like Alkane, Peak Resources and less than a handful of others. Even some of

those may have to “keep circling the airport awaiting a landing slot” until prices recover to levels that start to excite investor interest (which still hasn’t happened). The only ones to move forward in the very short term are those with either a strongly committed core investors (as Peak and Alkane have) or have serious offtakers prepared to advance money for the project build. This means that Alkane and Peak win the award for “REE developers most likely to produce” in the short term. We can think of one other REE company that might be able to nose ahead in the race, but it’s not a big field, and that would happen only if Alkane or Peak slacken their pace.

The two “must haves” are thus having a key supporter and having all plans at a “ready to build” point. Anyone who wants to go back to the drawing board at this point may find themselves still a developer in the mid-2020s.

Getting Real with Downstream

This brings us to the specific topic of Peak Resources. Their initial PFS called for a processing plant that was NOT in Tanzania so the crew at Peak decided that it was far better to locate their plant near to the customers (identified as being in Europe) and where costs and risks could be quantified.

In the end the result was the selection of the so-called Wilton site in the Tees Valley, in the northern UK. This area is a world renowned industrial centre with an established history and expertise in the chemical industry. The area has first class infrastructure including excellent roads, mainline rail services, an international airport and the UK’s fifth largest sea port.

The company justified the choice on the grounds that the United Kingdom met all of the technical and commercial requirements whilst offering some of the most competitive operating cost and commercial benefits.



Rustling Up Official Support

The key to setting this deal up was the support of the UK government through the Department for International Trade which includes UK Export Finance as well as locally from the Tees Valley Combined Authority. Having had reason to deal with them myself on “another matter” I have found UKTI and Teeside very keen to see cutting edge technology businesses move into the area to take up the brown fields sites left when shipbuilding and steel and other heavy industries went into decline. Therefore Rare Earths value-added processing and things like Lithium Ion battery recycling are things that push their buttons.

The Wilton site is also located within an Enterprise Zone with Enhanced Capital Allowance status. Companies locating in these sites can apply to receive a first year capital allowance of 100% on qualifying plant and machinery currently set to a maximum of 125 million Euros. The corporate tax rate is

currently set at 20% and will reduce to 17% from 1 April 2020.

Metallurgical Treatment Details

The mineralogy of the Ngualla Ore lends itself to a multi-stage mineral processing operation on site in Tanzania (Capex having been estimated US\$206 million) consisting of barite removal by flotation, regrinding and rare earth flotation. From this a high grade (>40% rare earth oxide) processed concentrate is produced. Peak has been evaluating a number of options from direct sale of this rare earth concentrate, toll treatment through third party facilities and, as a base case, the establishment of the proposed refinery in Tees Valley (with an estimated capex of US\$124 million) by the Peak or a refining partner

The refinery will comprise of an alkali roast, water leach, dilute acid leach, purification and finally rare earth separation via solvent extraction. The Tees Valley location brings with it access to chemical and electrical engineering resources, along with specialist contract engineering companies in Tees Valley for the planned maintenance program.



The major operating costs of the refinery are reagents and this makes the Tees Valley location particularly attractive given the proximity via ocean freight to multiple direct and by-product suppliers in UK and EU. As an example, the current cost of hydrochloric acid at Teesside, the primary reagent, is approximately 40% below the indexed cost seen in the Gulf Coast of the US over the past five years.

Conclusion

One thing that strikes us here is that Peak have effectively unbundled the mining side from the processing side and thus opened up the potential options for the future. For decades now the trend has been to site both mine and processing in

relative proximity. This thinking has largely sunk the bulk of REE players because to comply with the “logic” one had to locate large processing facilities in inaccessible, infrastructure poor locations with concomitant escalation in capex and the eternal enslavement to issues like the price of diesel. Without naming names one can think of a number of the once mighty wannabes in the REE space that came unstuck on insisting on building the totality of their operations in outlandish locations.

Dare we say it, but the way things are evolving Peak will also potentially have a stranglehold on processing the ore of other REE miners (if and when they should appear) due to the centralized European location, which would otherwise be unthinkable if the processing was inland in Africa. This in itself makes the funding of the processing component in the UK potentially separable from funding of the mine.

Peak are quite rightly throwing out the flawed hymnbook that REE developers, specialty metals producers and other miners have been singing out of for so long. Vertical integration does not mean all facilities have to be in the same place and in these days of cheap shipping rates it is more important to be near to the customers than near to a hole in the ground. This project will be one to watch in 2017 for next moves.

Uranium in Tanzania – The Next Big Thing?

The curious paradox of the moment is how one can meet so many people who are ultimately bullish on uranium while the price of the mineral remains at decade lows and stubbornly refuses

to get off it's behind. While capitulation was passed for many metals in the last few years, in uranium there is always a hard core of very logical people who sustain that its day in the sun is inevitable. We are amongst this group. It is very much a mindset of "buying straw hats in winter".

The last go around the hot spots were Namibia, the Athabasca (a perennial), Australia's Northern Territory and the US Sun Belt. Next time around we should see Tanzania figure prominently as the "Next Namibia". This is not to say that Tanzania didn't capture some of the heat last time around. Back then it was particularly in favour with Australian explorers and Russian strategic buyers. The transaction with Mantra Resources set the bar high, but it's now been years since the area received the focus it deserved so we thought it time to revisit.

Secrets is the Sandstones

Uranium mineralization in Tanzania was first discovered in follow-up exploration to country-wide airborne radiometric surveys completed in the late 1970's in which several anomalies were identified.

Uranium deposits in Tanzania are sandstone-hosted with the most significant deposits of this type contained within permeable sandstones. Mineralization occurs when oxidising fluids transport the uranium into sandstone, where it is deposited under reducing conditions. There are four main types of sandstone deposits, rollfront, tabular, basal channel and tectonic/lithologic. The host sandstones can be of differing ages with grades typically in the 400-4,000 ppm U.



Most of the active projects for potential uranium extraction are taking place in the Karoo structure, which is the violet coloured portion of the above map. A large part of the southern Tanzania geology comprises Karoo rocks, a 6,000 metre

thick succession of terrigenous sediments that accumulated in NNE-NE striking intracratonic basins during the Late Paleozoic-Early Mesozoic. The Karoo structure stretches through Malawi (the location of Paladin Energy's Kayelakera Mine – 46mn lbs grading 802 ppm U₃O₈) and then into Zambia (where GoviEx is just acquiring Denison's Mutunga project.

Most of the focus has been on the Ruhuhu Basin and Selous Basin. The Ruhuhu Basin is a typical east-African Karoo depositional sequence. The basal series comprises glacial deposits (hard to imagine, I concede, in sub-tropical Africa), which in turn are overlain by fluvial-deltaic coal-bearing sediments succeeded by arkoses and continental red beds. Transitional carbonaceous shales with coals gradually develop into thick lacustrine series which are topped by Late Permian bone-bearing beds. The depositional evolution of the Ruhuhu Basin was controlled by both tectonic and climatic factors. During the basin's evolution, important energy resources were deposited such as considerable resources of coal and source rocks of moderate potential for hydrocarbon generation. Uranium enrichment is observed in the Triassic arenaceous series with alteration and subsequent cementation.

The mainly sandstone-hosted Uranium deposits of Tanzania are of a type suitable for In-situ leaching ore extraction. About a quarter of the world's identified uranium resources are of the sandstone type, currently contributing to a major share of the world production of uranium. Some of these sandstone deposits are mined thru in situ leaching, which currently accounts for over 40% of annual world uranium production, which is low cost and can be brought into production faster than other deposit types.

The Legislative Environment

In 2010, the Tanzanian government passed the Mining Act of 2010, which increased royalties on gold and base metals to 4% from 3%; and rough diamond and colored gemstones, to 6% from

5%. Royalties on uranium were set at 5% and other minerals, at 3%. The new legislation also required companies to list domestically, allowed the Government to take a share in future mining projects, and restricted foreign participation in small-scale mining.

In early 2014, Reuters reported that Tanzania was “holding talks” with foreign companies planning uranium and nickel production in the country to ensure the government receives stakes under a 2010 law requiring it to take shares in strategic mines. The President claimed that local business leaders, politicians and activists were pressing the government to ensure Tanzanians benefit more from natural resources. He did not say what level of shareholding the government was looking to take in mines.

While this development was theoretically not news to miners, they do tend to ignore the issue until it rears its ugly head. There has been a change of government since that time but local ownership on the South African model is always a potential threat in the continent.

Mantra Resources/Uranium One

The story of the Mjuku River project is one of consolidation for enormous prices. ARMZ Uranium Holdings Company (an entity of Russia’s state-owned RosAtom) acquired the ASX-listed Mantra Resources in late 2010 for US\$1.15bn. ARMZ initially purchased a 17% stake in Uranium One in 2009 but then moved to 100% control of Uranium One in January 2013.

Mkuju River (confusingly also known as Nyota) is a uranium development project located in southern Tanzania, about 470 km southwest of Dar es Salaam. The Mkuju River project was originally owned by Mantra Resources, in which Uranium One had a minority interest. Uranium One also owned part of the Tanzanian project company directly.

In 2010, Mantra Resources completed a prefeasibility study at

the Mkuju River project. The study estimated that the Nyota property could support a new uranium mine with average production of nearly 1,700 tpa of U_3O_8 . Mantra estimated the resources at Nyota as 108.9mn tonnes at a grade of 0.04% U_3O_8 . The latest stated resource we could find was a Measured and Indicated resource of 101.4mn lb U_3O_8 grading 404 ppm U_3O_8 .

Uranex (formerly ASX:UNX)

This company has been morphing into and out of and then back into Tanzanian uranium in recent years. Several years back it announced a maiden Measured & Indicated resource of 6.1mn lb of U_3O_8 grading 237 ppm and a 15mn-25mn lb (at 200-400 ppm U_3O_8) exploration target range for its Likuju North Prospect.

Uranex were busy beavers in their heyday. They undertook a prefeasibility study on the Manyoni project with a projected seven-year life and a capacity of between 350 and 400 tpa of U_3O_8 . It also considered extending the study to consider heap leaching that could increase production and mine life. It had announced a revised resource estimate of 92mn tonnes at a grade of 0.014% U_3O_8 .

Uranex also explored at the Mkuju project in southwestern Tanzania in 2010. The 5000 km² Mkuju Uranium Project adjoins the aforementioned Mkuju River of Uranium one (ex-Mantra).

We guess it's not surprising but with Uranium looking so grim, Uranex tossed its efforts in the yellow mineral and shifted to graphite in 2014, changing its name to Magnis Resources. This move worked out for it (one of the few).



And now... Surprise... it is demerging its uranium assets into a new vehicle via a pro rata distribution of shares in Uranium Africa Limited (ASX:UAL). This happened in recent days, which may indeed represent the first swallow of a nuclear summer (to

mix a metaphor).

Karoo Exploration (TSX:KE.H)

Karoo has gone into that dark place on the TSX-V where they append a H to your ticker and the executives just hope the monitor doesn't start to flatline. Such is the state of things that holding territory in the promising Mkuju east project area, with its covering of Karoo sediments, is not enough to keep the grim reaper from the door.

Karoo owns a 100% interest in five uranium licences, encompassing 953 km² in the Selous Basin of southern Tanzania. A total of 27 anomalies were identified using airborne radiometric data to refine ground targets. At last report, the company had made applications for an additional 2,137 km² in the Karoo Basin.

Uranium Resources PLC (URA.L)

The company's main target is the 1,200 km² Mtonya project located approximately 60 km south of Uranium One's Mkuju River Project and 100 km east of the district capital of Songea. Its geology consists of Usagaran orogenic basement rocks in the west and sediments of the Luwegu Sub-basin of the Selous Basin in the east. Roll-front style uraniumiferous mineralisation hosted by the Karoo sandstone units is thought by the company to be analogous to that of Mantra's Nyota deposit, which contains an inferred resource of 55.8 mn lbs of U₃O₈.

The completion of the 26,485m resource-definition drilling programme in 2012 resulted in the announcement in 2013 of a maiden CIM-compliant Inferred Resource of 2.014mn lb U₃O₈ grading at 255 ppm. Pretty small stuff though in our estimation.

The problem we have with this company is that during the long drought in investor interest it took a dripfeed of funds from

a Russian source (Estes Limited – not a household name, though one of its directors is named Medvedev) and in the process has ended up majority controlled by them without the “benefit” for shareholders of a takeover. Estes now owns 417mn out of the 746mn shares on issue.



Uranium Resources said it is expecting the Mtonya licence to be extended but conceded that it cannot be guaranteed, with the delay in approval being exacerbated by the change in government in Tanzania following the general election.

Conclusion

Our exposure to Tanzania in recent times has been limited to Peak Resources with their REE project in the Southwest of the country. The number of uranium projects, even at the metal's recent highs (admittedly a few years ago now) were never many but the whopping price paid for Mantra put Tanzania on the uranium map, alas just before the massive dieback of uranium explorers.

One thing of note is the on-going intense Russian interest in Tanzania that somewhat mirrors the Chinese interest in Namibia.

With Tanzania regarded as one of the better jurisdictions in Africa these days, we would expect it will be a first port of call when the uranium liftoff takes place and we find the spin-off from Magnis of a new vehicle as a promising sign that reactivation is not necessarily going to await the spot price stirring from its slumbers.

Rightsizing as a Prelude to Project Liftoff for Peak Resources

For those needing reminding, Peak Resources Ltd's (ASX: PEK) main asset is the Ngualla Rare Earth project that is located in southern Tanzania, some 147 kilometres from the city of Mbeya on the edge of the East African Rift Valley. The project is centred upon the Ngualla Carbonatite and was prospected for phosphates in the 1980s by a joint Tanzanian-Canadian university team. The rare earth element (REE) component is a relatively recent discovery with Peak having identified this in 2010. In the company's opinion it is one of the highest grade of the large undeveloped rare earth deposits in the world.



Premises of the Revised PFS

A couple of weeks back Peak came out with its long-awaited revised PFS. In this day and age of "rightsizing" of projects for the new exigencies the "updated PFS" is becoming a more regular feature. While that is one of Peak's motivations another is that it has rethought several of its key premises and changed its technological focus and as well as its processing location. A key element of the revised PFS involved a focus on the production of Neodymium and Praseodymium to meet demand for high powered permanent magnets.

With a focus on Neodymium and Praseodymium, the Study was based on extensive metallurgical flow sheet development work and pilot plant programs completed since delivery of the PFS. The study also included engineering simulation and mass balance modelling conducted in conjunction with lead engineers, Amec Foster Wheeler.

The base-case scenario envisaged production of approximately 2,300 tonnes per annum of Neodymium and Praseodymium rare earth oxide, 250 tonnes per annum of mixed Samarium, Europium and Gadolinium Rare Earth carbonate and 5,900 tonnes per annum of Cerium/Lanthanum carbonate. Production forecasts are based on the weathered Bastnaesite Zone Mineral Resource estimate at a 1% Rare Earth Oxide lower grade cut-off (Measured and Indicated portions only).

The Process

It would be useful to expand on the new process which the company sees as a key factor in reducing opex. The previous PFS leach recovery flowsheet was based on treating a medium grade (~17% REO) concentrate with a high content of acid soluble iron. A "Double Sulphate" route was employed to reject the dissolved iron whilst increasing the Rare Earth concentration in the feed to the solvent extraction (SX) separation feed solution. The new scenario employs Alkali Roasting which is a four-part process designed to eliminate the low value Cerium component early on. The Alkali Roast Process has been developed and optimised for Ngualla's concentrate at both Nagrom and ANSTO test facilities and has been demonstrated at bench scale as a viable flowsheet.

The key advantages are:

- Reduced plant capital cost through a smaller plant of modular design
- Lower operating costs due to reduced reagent consumption
- Focus on the extraction and recovery of the high value magnetic metals praseodymium and neodymium
- Significant reduction in the extraction of low value cerium, further reducing reagent costs in the leach recovery circuit and also the size of the downstream separation plant
- Minimises the extraction of deleterious elements thereby simplifying the purification process



These four phases are:

Alkali Roasting – The bastnaesite concentrate is mixed with a common alkali and roasted in a standard tube furnace at approximately 700°C for one hour. This is a dry, free flowing process in contrast to the “sticky” acid baking process employed for monazite or xenotime hosted rare earth concentrates.

Water Wash – The fluorine present in the bastnaesite, which would be problematic to downstream purification and separation processes, has been converted to a soluble form during the alkali roast process and is removed using a simple water wash. The filtered solid is then suitable for selective leaching.

Selective Leaching – A low strength (<1%) hydrochloric acid leach selectively targets the desired high value rare earths (neodymium and praseodymium) whilst rejecting large amounts of the low value rare earth cerium along with gangue elements such as iron. The low leach temperature of 80°C and mild acidity means that low cost polymer tanks can be used both in the pilot plant and on a commercial scale.

Purification – Residual leach impurities are removed by precipitation using lime slurry. The waste precipitate is removed from the solution using simple filtration. The filtrate is depleted in cerium but high in neodymium and praseodymium and is suitable for direct feeding to the SX Separation circuit.

ANSTO has been selected for the piloting of approximately two tonnes of high grade (>40% REO) concentrate produced from the beneficiation pilot plant. The pilot plant setup at ANSTO is nearing completion.

Rightsizing the PFS

The Study has updated operating costs to US\$97 million per annum, an 18% reduction (US\$21 million per annum) compared with the PFS. The operating cost reductions have been achieved through optimisation of the flowchart using the aforementioned Alkali Roast process.

Capex was also reduced by just over 10% from \$367mn to around \$330mn. This still contains a mighty contingency factor which in these days of mining cost deflation would hopefully come down or be eliminated. Our back of the envelope estimate of how this might be apportioned looks like:



This is not the end to potential Capex reductions as a number of capital cost items currently included in the revised Capex estimate (Power Plant Gensets US\$8mn, Accommodation Camp US\$12mn and Mining Fleet US\$10mn) will be reviewed as part of the Bankable Feasibility Study. The company claims that it is likely some or all of these capital costs could be moved into operating costs through Build, Own, Operate, Transfer (BOOT) style contracts. The site layout is shown below:

We gather the idea is that there will be some competition in European circles to achieve the plant siting in particular countries which should expedite the financing of that portion, leaving the company with the task of funding the minesite via offtakes. We would note the past history of the Japanese (JOGMEC) having funded REE exploration in East Africa. If one combines output from Ngualla with that of Lynas, then the Japanese would be pretty much free of Chinese dependence in the key magnet REOs.

The Resource & Mining Inventory

The latest total Mineral Resource estimate for the Ngualla Project using a 1% REO cut-off consists of 214.4 million tonnes at 2.15% REO, for 4,620,000 tonnes of contained REO. Included in the total Mineral Resource is the weathered

Bastnaesite Zone which forms the core of the development study. At a 1% REO lower grade cut-off the Mineral Resource estimate for the weathered Bastnaesite Zone is 21.3 million tonnes at 4.75% REO, for 1,010,000 tonnes of contained REO.

The improved mine plan included a Mining Inventory which was essentially the material within the pit-shell outline.



This is shown below:



As can be noted the grades are exceptionally high within the pit-shell to maximize upfront revenues. It's worth noting that, as well as being high-grade, Ngualla's rare earth mineralisation has a high proportion of the important permanent magnet metals, Neodymium and Praseodymium, a significant advantage over other rare earth deposits.

Catching Some Big-Fish Partners

The winnowing of the Rare Earth space has meant that the few players standing are generally those that have found credible partners.

In the case of Peak, its strategic partnership is with the resources fund manager, Appian Natural Resources Fund LLP and the International Finance Corp. The latter in particular is quite a stamp of approval as this supranational investment fund backs very few mining ventures and has backed no Rare Earth ventures until now.

The first part of the relationship was put in place in February of 2015 as part of a transaction amounting to a total of AU\$31.8mn. The goal of this was to finance the BFS. It was composed of:

- Stage 1: received AU\$20mn

- Stage 2 & 3: to be received AU\$11.8mn

The transaction involves staged investments at different levels of the project structure with Appian and IFC are investing on an 80:20 basis.

The arrangement (as visualized in the chart below) is that these partners have a total stake of 19.99% in the master listed vehicle, Peak and then 37.5% in the operating subsidiary, PAM and on top of this a 2% Gross Smelter Royalty.



These investors have formed a partnership to invest in African projects with Peak being the lead target at this time. The other investment they have made together is the Burkina Faso gold play, Roxgold (ROG.v).

Peak sees the partners as collaborative and long-term. We might also add that having the IFC is somewhat of a guarantee that one might have more “consideration” from local administrations due to the organisation’s international importance to emerging economies.

Conclusion

In Rare Earth circles these days, it is not only the quality of a company’s deposit that it is important, but also the quality of the company it keeps. Peak has bagged heavyweight shareholders in the form of Appian and the International Finance Corporation. This is a mighty endorsement in a mining sub-space where many have spoken of strategic investors but few have been able to actually get them onto their share registers. In Peak’s case they are present at both the listed vehicle and the project levels.

In summary certain fundamental geological aspects offer distinct advantages for development over other rare earth projects. These include:

- large size of the deposit
- outcropping high grade mineralisation amenable to open cut mining with low strip ratios
- favourable mineralogy amenable to a relatively simple, low cost processing route
- extremely low uranium and thorium levels

Again, in Peak, we find a case of “hare & tortoise” with a below-the-radar REE hunter moving further down the road to the end goal, verily as some of the household names of the REE space fold up their tents for the last time having burned through enormous piles of money with nothing to show. Instead the company has spent the “downtime” of the last two years, proving up its resource and getting its thoughts in order for a cogent production plan. With the team in place and the reformed capex plan in hand, the all-important funding phase begins.

To access the Hallgarten & Company research report titled – **Peak Resources: Updated PFS puts African REEs in Picture** – [click here](#)