Appia Rare Earths & Uranium by the numbers

written by | July 25, 2022

Appia Rare Earths & Uranium Corp. (CSE: API | OTCQX: APAAF) recently reported results from its 2021 drilling program and work completed this year on its Alces Lake property in Northern Saskatchewan. While results are still pending from the 34 holes drilled at the recently renamed site Magnet Ridge (formerly Augier), other areas returned values as high as 14.95% TREO over 0.66 metres. This is high compared to most deposits. As of early July Appia has drilled over 14,000 metres in 2022 and plans to drill up to 20,000 metres this year, which should provide them with valuable information on the Alces Lake deposit. Magnet ridge is interesting as Appia has reported it outcrops at surface with a strike length of about 300 metres and a width of 175 metres, and has been penetrated to over 100 metres deep.

The mineral hosting the rare earths at Alces Lake is monazite. Monazite is regularly processed in China to produce rare earths, so making a concentrate and separating the rare earths is an established technology. In several jurisdictions, this could be a problem as monazite is typically associated with the radioactive elements Thorium (Th) and Uranium(U). However, it comes down to the old paradigm, location, location, location. Being situated in Saskatchewan, Appia is in a jurisdiction that understands radioactive materials and that they can be properly handled and stored, and in the case of uranium can be a valuable resource. The other advantage for Appia being in Saskatchewan is that the Saskatchewan Research Council is building a pilot plant for rare earth separation over the next 2 years. This will give Appia the ability to test their material locally, which is a significant advantage.

A 2020 Appia presentation indicates Neodymium (Nd) oxide levels of 17.4% and Praseodymium (Pr) oxide of 5.4% which gives a combined total of just under 23%. This is close to the Lynas levels from its Mt. Weld deposit, which Roskill's Market Outlook 2015 indicates to be 23.8%. The Mountain Pass Mine, the deposit in California owned by MP Materials, has Nd+Pr levels at 16.3%. so they would have to process up to 50% more material to get the same revenue levels as Appia or Lynas. In addition, Appia's report shows added value in Terbium (Tb) and Dysprosium (Dy). Looking at recent pricing in Shanghai Metal Markets (SMM), the Nd/Pr holds 87.8% of the total value. Terbium and Dysprosium add another 0.3%. This assumes that all the elements are sold, which typically is impossible, especially the Cerium, which is over 49% of the total volume. However, there may be markets in North America and possibly Europe for Cerium and Lanthanum. Their current price in China is $1.22 and $1.15 per kg respectively and freight can be a high proportion of the total cost of the product outside of Asia.

One way to look at the value of the deposit is to see what potential revenue can be generated from the four main magnetic elements (Neodymium, Praseodymium, Terbium and Dysprosium). Assuming the long range plans would be to build a 20,000 TPY plant, which is similar to the previous Molycorp output and just below the Lynas present output of around 22,000 TPY, their projected revenues would be around US$500 million per year. This assumes 90% recoveries and revenues only from Nd+Pr. Any sales of Cerium and Lanthanum would be minimal but an added bonus.

In addition, Appia has properties in the Elliot Lake area in Ontario. This is in the right area code as from the mid-late 1950s to 1990 there were 10 mines producing Uranium. Again location, location, location. Given the push for electric vehicles and the corresponding increase in electrical demand, countries are going to review their long term needs including

Germany and China, and possibly India, and given alternative producing options nuclear is a cleaner way than coal or gas to produce electricity. Also given the current Russian situation more focus will come on nuclear and correspondingly Uranium. Thorium may also come into demand as it can reduce the operating temperature and thereby improve safety.

All things considered, Appia has an interesting opportunity and with the grades shown so far, and is poised to take the next steps to becoming a potential domestic producer of rare earths.

Iluka Resources looks to join exclusive club of rare earths producers

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Iluka Resources Limited, (ASX: ILU) an Australian mineral sands company, is poised to add rare earth elements to its portfolio of products. The company's main products are zircon, titanium, plus iron and carbon materials from its processing plants in Australia. It also has recently announced the de-merger of its Sierra Leone company, Sierra Rutile Holdings Limited, to end up with two ASX listed companies.

The plan announced by Iluka is to start concentrating monazite and xenotime in the second half of this year from its mineral sands operation in Western Australia. Cracking and leaching will begin next year followed by separation to produce rare earth oxides in 2024 at Eneabba, Western Australia, which is a 3

hour's drive north of Perth. According to public company information, the planned output is 17,500 tons per year of Total Rare Earth Oxides (TREO). They note the plant will have a full capacity of 23,000 TPY of TREO with all circuits fully utilized. It is reasonable to assume that they are looking for additional monazite to fill their plant as the capacity is more than they can produce themselves.

Based on the feed rate of 17,500 TPY TREO Iluka expects to produce 4,000 TPY of Nd/Pr plus 500 TPY of Dy/Tb. Typically, Dy:Tb ratio varies from 2:1 to 5:1. At today's pricing of $135/kg USD for Nd/Pr oxide, Dy oxide at $362/kg USD, and Tb4O7 at $2.056/kg USD, Iluka's annual revenue could be in the range of US$1 billion.

The projected capital costs are AU$170-200 million for the cracking and leaching, and AU$320-390 million for the separation and finishing. Additional costs include plant and infrastructure AU$110-140 million plus indirect costs, contingency, commissioning and miscellaneous costs of AU$400-470 million for a total of AU$1-1.2 billion. According to the company, there will be support from the Australian government in the form of a loan from the government's Critical Minerals Facility fund and a risk-sharing agreement that would include non-recourse debt, royalty payments to Iluka, and flexibility in repayment schedules. This is what is necessary to get these projects off the ground – government support and vision to see that risk sharing is very important.

Raising this amount of capital in the markets today is a challenge and also very dilutive as their current market cap is AU$3.8 billion. An advantage Iluka has over many other planned entrants into the rare earth space is their existing cash flow from current operations, as it will take time to generate revenues from this operation after construction begins this year

and until the first output is expected to be seen in 2025.



Source: Iluka Company presentation, April 4, 2022

Based on using their existing stockpile at Eneabba, Iluka could produce 12,400 TPY TREO with an operating cost of AU$13/kg or about US$10/kg which is competitive with Chinese costs. I am assuming they put no value on the feed material as it is in a stockpile. They have not included any transfer costs from other sources in their expanded production estimates with other sources of feed. The stockpile feed would produce 2,700 TPY of Nd/Pr or about half of the capacity of 5,500 TPY of Nd/Pr. This stockpile would be exhausted in 9 years, so they are actively looking for other sources to fill the plant.

One question that is not clear is whether they will take a Molycorp plant design approach or the Lynas approach. Molycorp originally designed a single train 20,000 TPY TREO capacity. Lynas built four 5,500 TPY TREO trains so that if supply or demand changed, or there was a problem in one train, they did not lose all their production. This came to light over the COVID era when demand dropped. This is a major consideration of any new plant design as economies of scale are limited or offset by potential operational problems.

Overall this may well be one of the players to cross the finish line in the race for more production of rare earths outside China.