Are Ionic Adsorption Clay Deposits a Game-Changer for the Supply of Rare Earths

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Rare earths are a key building block in critical components found in modern technologies such as electric vehicles, wind turbines, and smartphones.

Over the last two years, there has been an abundance of discoveries of rare earths mineralization called Ionic Adsorption Clay (IAC), characterized by the extensive low-grade deposits in Southern China. Australia leads the way due to its long-lived and continent-wide deeply oxidized weathering environment considered necessary for these deposits to form. Barely a week goes by without a new discovery. But are these deposits genuinely IAC and does it matter?

While the abundance of these deposits has sparked investor interest, questions remain about their true nature and the economic viability of development.

The types of rare earths deposits

We need to set the scene for rare earths (REE) deposits to answer that question. REE deposits are well documented and are dominated by:

- Alkaline igneous rocks such as carbonatites, granites, and felsic volcanics;
- Hydrothermal altered calc-silicate sequences; and,
- Secondary regolith clay-hosted deposits.

Reworked alluvial accumulations rich in monazite are clearly a separate type but becoming increasingly important as a competing source of REEs.

Regolith clay hosted deposits and the formation of IAC deposits

Regolith deposits develop by the weathering of the underlying host rock to form a variety of secondary clays and other oxidized products. Important source rocks typically have a relatively high background in rare earths and rare earth bearing minerals in these rocks will include monazite, xenotime, bastnaesite, allanite, titanite, and apatite.

Minerals like bastnaesite, allanite, and titanite are most susceptible to the acidic ground waters that develop in the upper levels of humus-rich soils in temperate or tropical climates, with moderate to high temperatures and rainfall. The REEs from the decomposed minerals migrate downwards as REE-ions in solution which can adsorb onto clay minerals such as kaolinite and become IAC deposits.

Alternatively, the percolating solutions can combine with phosphate or carbonate to form secondary minerals (often in a colloidal phase) in a neutralization step. The more resistive minerals such as monazite and xenotime remain unaltered and can accumulate physically with partial removal of the surrounding oxidized rock by the weathering process.

The “does it matter” question

So we have the three types of rare earth accumulations in a regolith profile which gets us to the “does it matter” question.

The geometallurgy, capital expenditures (CapEx), and operating expenditures (OpEx) of a mining and processing facility, and the marketability of any products produced drive the economic development of any rare earths deposit.

In regolith deposits, the Chinese found that weakly acidic ammonium sulphate or sodium chloride solution readily reclaims the rare earths from the ionic bonded clays allowing the resulting crude solution to be chemically treated to eliminate contaminants for further solvent extraction separation and refining. This processing can be in-situ leaching; heap leaching; or in-tank leaching with increasing cost and all with significant environmental impact.

Generally, Chinese costs for REE reclamation from IAC deposits are low and despite the low recoveries peaking at around 30% to 40% in final products, these projects appear to be economic.

Economic challenges of other regolith deposits

The other regolith deposits require more sophisticated processing with higher costs from increased upfront chemical consumption (sulphuric acid) after mining from open-cut operations and subsequent processing, including removal of significant contaminants from the acid leaching. There have not been many colloidal-type deposits identified to date, and it appears many of the new group of announced deposits could be clay-hosted, residual monazite-xenotime accumulations and not true IAC. Solubilizing monazite and xenotime is a known commercial process and the costs are well-defined but are significantly greater than for IAC extraction. The processes to recover REs from resistate minerals in the near horizontal deposits at depth will require environmentally sustainable mining, potentially covering large areas.

If this is the case then it will be very interesting to see how many of these low-grade, sub 2,000 parts per million (ppm) or 0.2% of total rare earth oxides, will be economical to produce or do they have a touch of hype at present.

Final thoughts

The economic viability of IAC deposits remains uncertain, with questions about their true nature and the costs of mining and processing. While the Chinese appear to have developed a low-cost method of reclaiming rare earths from IAC deposits, other regolith deposits require more sophisticated processing with higher costs and the potential for significant environmental impacts.

So, yes investors would be wise to understand the deposit type and geometallurgy before investing.