intertek minerals

FACT SHEET

IONIC LEACH ANALYSIS FOR REEs

REEs have numerous applications but have been increasingly important in the development of technologies to reduce our carbon footprint with the production of permanent magnets used in electric vehicles and wind turbines.

Overview

Rare earth elements (REEs) are classified as the 16 elements on the periodic table including the lanthanide group, yttrium, and scandium. The lanthanide group of REEs can be classified into three categories, light rare earth elements (LREEs) consisting of La, Ce, Pr, and Nd, middle rare earth elements (MREEs) Sm, Eu, and Gd, and the heavy rare earth elements (HREEs) comprising of Tb, Dy, Ho, Er, Tm, Yb, and Lu.[1]

REEs have numerous applications but have been increasingly important in the development of technologies to reduce our carbon footprint with the production of permanent magnets used in electric vehicles and wind turbines.[2] The rare earth market is currently dominated by China with the majority of the ore mined in the country, and over 95% of the final magnet product, produced there.[3] This has led to REEs being classified as critical metals.

Challenges

REEs typically do not form concentrated ores making finding economically viable source difficult and can potentially have significant environmental impacts due to the amount of ore required to be mined. Typically, REEs are found in carbonate minerals such as bastnasite and phosphate minerals such as monazite and xenotime. These minerals are refractory and require extraction at high temperatures using concentrated sulfuric acid, hydrochloric acid, or sodium hydroxide.[4]

Alternatively, REEs can be clay hosted. The weathering of the labile REE containing minerals mobilizes the REEs and they electrostatically adsorb on the surface of clays. The ability of the REEs to adsorb on the surface of clays is due to the activation of negatively charged binding sites caused by charge imbalances in the clay due to substitutions of Al^{3+} and Si^{4+} in the crystal structure of the clay[4,5]

95 PERCENT

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Clay hosted REEs open the door for economically viable REE concentrate production due to the relative ease of which the valuable elements are extracted from the clay. This is achieved with an ion exchange reaction using sulphate or chloride solutions of ammonium, manganese, lithium, cesium, or sodium.[6] Currently, there are no sites producing REE concentrates from ionic clays outside of China[7], however, significant work is being conducted in Australia, the Americas, and Africa to identify ionic clay hosted REE deposits.

Methodology

One must be careful with clay hosted REEs deposits as the mineralogy may identify that they are clay hosted but not they are not necessarily ionically exchangeable. This leads to similar issues with the mineral hosted REEs where significant effort is required in the extraction process.

Intertek Minerals is offering a bench top ionic leach method for the identification of ionic clay hosted REEs. When coupled with a full extraction method such as a peroxide or borate fusion, you can determine the proportion of REEs in your ore that is ionically exchangeable. The base method Intertek offers uses 0.1M ammonium sulfate at a pH of 3 for the quantification of ion exchangeable REEs. The concentration of ammonium sulfate, pH, and leach times are fully customisable to suit your needs. In the instrument analysis stage, there are typically many interferences between the REEs. Intertek Minerals utilises our ICP-MS-QQQ technology for this method for interference-free analysis to ensure you get the best detection limits for this method.

ICONIC LEACH
ANALYSIS FOR REEs

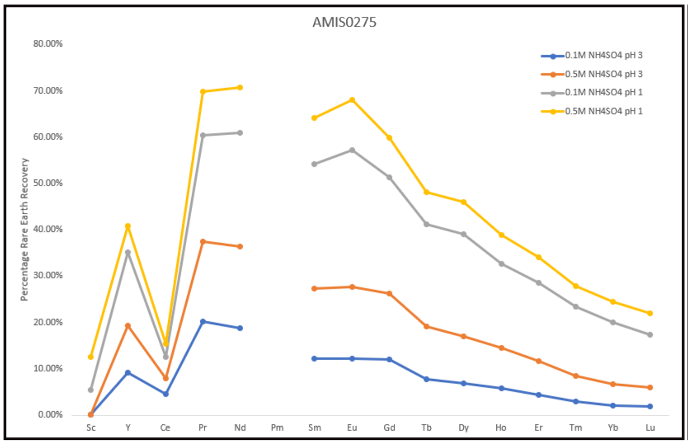

Figure 1: Recovery of Rare Earth Elements from Iconic Leach Method for AMIS0275

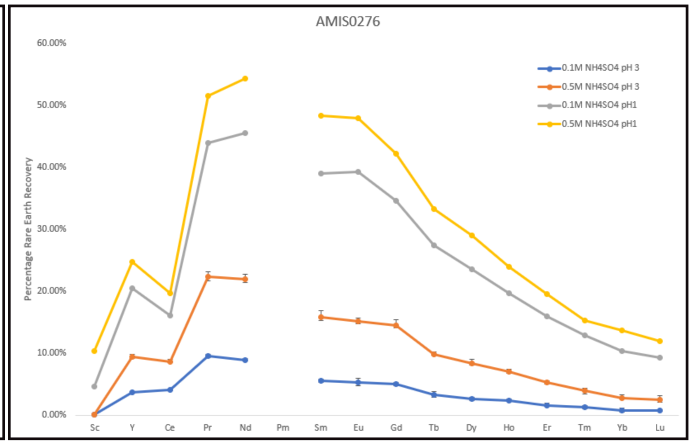

Figure 2: Recovery of Rare Earth Elements from Ionic Leach Method for AMIS0276

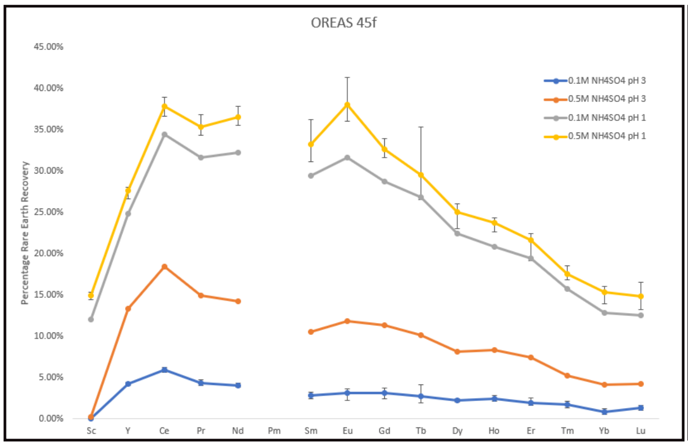

Figure 3: Recovery of Rare Earth Elements from Ionic Leach Method for OREAS 45f

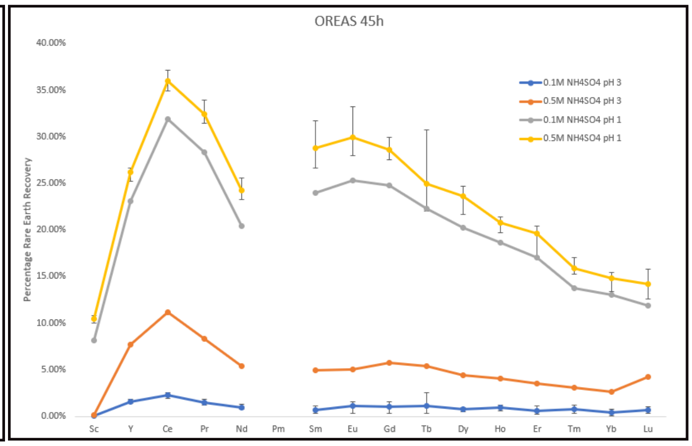

Figure 4:Recovery of Rare Earth Elements from Ionic Leach Method for OREAS 45h

Case Study Results

A case study was conducted on a series of certified reference materials (CRM's) with ionic hosted REEs, using the ionic leach method offered by Intertek. The recovery of the REEs from the ionic leach method was determined at different concentrations of ammonium sulphate (responsible for the ion exchange) and pH levels as shown in Figures 1-4.

As expected, the recovery increases with an increase in ammonium sulphate concentration and decrease in pH. What can be seen in the test work is that the recovery varies across each of the standards tested as well as for each of the rare earth elements. The recovery is maximized for the elements Pr, Nd, Sm, and Eu for all reference materials tested with the recoveries decreasing either side.

Intertek Minerals is able to meet your needs for your ionic clay hosted rare earth samples with a customisable ionic leach method combined with complete quantification of the total REEs in your sample to determine the percentage of ion exchangeable REEs.

Learn more learn how we are driving innovation and sustainability across the minerals supply chain through advanced technology and innovation, automation, and robotic systems: www.intertek.com/minerals.

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FOR MORE INFORMATION

+ 61 8 9263 0100

min.aus@intertek.com

intertek.com/minerals