

Thermodynamics of Exchange in Ion Adsorption Type Rare Earth Ore

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Under lateritic weathering conditions, rare earth element (REE) cations can be adsorbed onto or incorporated into clay minerals to form ion adsorption clays (IAC). Between 60-90% of the REE exist in the exchangeable form [1], where they can be easily recovered, using an electrolyte solution (e.g. $(\text{NH}_4)_2\text{SO}_4$), via an ion exchange mechanism.

IAC are only mined in China, where largely unregulated mining practices have led to severe environmental consequences, including groundwater contamination and deforestation. [2] estimate that 300 m² of vegetation is removed for every 1 t rare earth oxides mined from IAC. In-situ recovery is considered an attractive alternative to surface mining.

This paper investigates the mobilisation of the REE from an IAC from northern Madagascar based on batch and column tests. The experimental dataset is used to determine thermodynamic equilibrium constants (log K) for REE- ion exchange reactions. These constants are not available in literature.

A single log K (as a preliminary modelling approach) for all the REE is able to effectively describe the batch and column datasets. Based on these findings we will test the feasibility of an alternative mining approach to extract REE from the IAC, with the focus on reduction of the environmental impacts.

[1] Moldoveanu *et al.* (2012). *Hydromet*, **117**, 71–78.

[2] Yang *et al.* (2013). *Environ Develop*, **8**, 131-136.

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