The speciation of Rare Earth Elements in wastes from acid mine drainage: a structural approach to design their recovery

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The high demand of Rare Earth Elements (REE) for the technology and industry development together with their low supply requires a further investigation for new resources. Acid mine drainage presents high REE concentrations, which are totally retained in wastes of passive remediation systems.

In this work, different techniques, including High Energy X-ray Difracttion (HEXD), Extended X-ray Absorption Fine Structure (EXAFS) and Ab-Initio Molecular Dynamics (AIMD) were used to describe both the geometry of the aqueous complex YSO_4^+ and the local order of yttrium adsorbed onto basaluminite (Y is chemically similar to a high REE, Tb-Lu), and to identify the yttrium speciation in wastes from passive remediation systems simulated at the laboratoy scale.

Pair Distribution Functions (PDF) analyses from experimental solutions and models from AIMD simulations show that the aqueous YSO_4^+ species is a contact ion-pair, with a monodentate ligand between Y and SO_4. EXAFS and PDF analyses show that Y is adsorbed at the basaluminite-water interface forming an inner-sphere surface complex via a monodentae ligand. This species represents more than 70 % of the adsorbed yttrium.

Furhter investigations with light REE (La-Nd) will help to design methods for the separtation of REE and to evaluate the cost effective character of their recovery.