Bio-extraction of REE and other valuable elements from red mud left after alkaline processing of gibbsite bearing sediments, Sinai, Egypt

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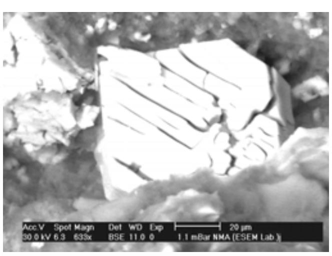
The use of microbial uptake for trace elements was tested on gibbsite bearing sediments from southwestern Sinai, Egypt as well as red mud left after alumina extraction using Bayer process. The red mud slurry contains valuable elements such as Mn, Ni, Co, Cu, Zn and REE. The alkalinity of the slurry was adjusted to pH 4 - 5 before subjecting to microbial culture. The microorganisms could not tolerate high aluminum content in the original samples mainly due to the effect aluminum toxicity.

The SEM-EDX investigations show the effect of colonized microorganisms in perturbing red mud chemistry via selective dissolution and re-precipitation in biological active layer. The most frequent elements that accumulated in the biomass layer, which may serve as energy source, are K, Na, Mg, Ca, Mn, Zn, Cu, Co, S, P and REE. The REE enrichment in LREE or MREE differ quietly according to experiment conditions (Fig.1).



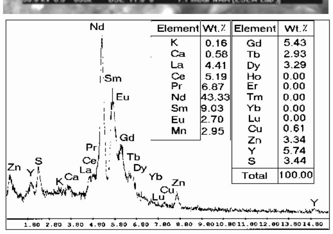


Fig. (1): SEM image shows REE bio-extraction in crystal like habit from red mud slurry.

Fig. (2): EDX analysis of the biologically precipitated REE in crystal like form.

Microbial selenate reduction in a selenium-contaminated watershed

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Selenium continues to be a persistent environmental problem as a result of human activities such as irrigation of seleniferous soils, pesticide applications and mining operations. The oxyanions selenate and selenite are most prevalent in the environment and their toxicity is a function of their analogy to sulfur compounds. Mining operations in southeastern Idaho over the past 80 years have led to extensive leaching of selenium oxyanions from seleniferous overburden resulting in selenate contamination of waters and soils within the region. As part of a larger study of the controls on the biogeochemical cycling of selenium within this environment, the microbial reduction of selenate was investigated. Several selenate-reducing microorganisms were enriched and isolated from seleniferous shales. Isolates were identified and further characterized. Cores taken from the watershed region were used to quantify total numbers of selenate reducers within sediments as a function of depth. Denaturing gradient gel electrophoresis was used to compare the microbial diversity within sediments having high numbers of selenate reducers. The results of the study will provide information regarding which microorganisms affect the transport and mobility of selenium oxyanions in the environment, and may be beneficial towards the design of strategies to prevent selenium dispersal.