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Developing alternative resources of rare earth elements in Europe – EURARE and the red mud challenge

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Rare earth elements (REE) are considered to be highly "critical" by the European Commission [1], owing to the concentration of global supply [2] and their use in a wide range of emerging technologies (e.g. smart phones, electric cars and wind turbines). The main source of REE is the mineral bastnäsite, which is primarily extracted from carbonatites. Alternative resources of REE have been identified in a variety of other environments such as alluvial placers, bauxites and ore tailings. The EURARE project (www.eurare.eu), funded by the European Commission, aims to improve understanding of potential REE resources in Europe with the overall objective of establishing the basis for a European REE industry. As a part of this project, alternative sources of rare earth elements in Europe are being considered.

REE have been identified as being particularly enriched in karst-bauxites and hence in the red muds generated as a waste product from the processing of these bauxites to alumina through the Bayer process [3]. Karst-bauxites are widely distributed with deposits known across the Mediterranean and with intermittent exploitation occurring over many decades. REE become concentrated in the bauxite deposits by the bauxitisation process and are retained due to the geochemical barrier created by the limestone bedrock below. This can result in several processes, including the crystallisation of authigenic REE-bearing minerals, the accumulation of residual phases and the adsorption of ions onto clays and other mineral surfaces [4]. Red muds produced from alumina processing represent a potentially important concentration of REE as it has been demonstrated that the REE pass through the alumina extraction process into the waste, and the total REE concentrations are typically enriched by a factor of two compared with the original bauxite ore [5].

Bauxites and red muds from the Parnassus Ghiona region of Greece [6] and the Seydişehir-Akseki region of Turkey have been assessed as part of this study. Red muds from these deposits contain on average 900 ppm REE compared with typical values of <100 ppm to ∼500 ppm REE in the bauxites. Extraction of REE from red muds has been shown to be feasible [5,7] although it is challenging due to the heterogeneous spatial distribution of REE in the primary bauxite deposits [8], an unclear understanding of the mobility of REE in red mud tailings ponds, and the need for development of appropriate processing methods. However, the resource potential of red muds in Europe is significant with approximately 3.5 Mt of bauxite ore extracted in 2012 [2], resulting in approximately 1.4 Mt of red mud from the production of alumina. In addition a large volume of stockpiled red muds exists from historical processing of bauxites, the total of which is not well constrained. Understanding the REE potential of both bauxites and red muds is integral to an assessment of European REE resources.

References

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Additional resources: www.eurare.eu; www.redmud.org.