Extraction of Rare Earth Elements from Umbers by simple leaching and oxalate precitpitation

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Field evidences and geochemical characterisation of umbers from the Troodos Ophiolite, Cyprus, show strong similarities with high-temperature plume fall-out deposits observed in most mid-oceanic ridge settings [1]. Umbers constitute fine-grained brown Fe-Mn-rich mudstones with amorphous oxyhydroxide mineralogy, total rare earth oxide TREO ≈ 0.05 wt. % and extremely low radioactive content (Th + U < 5 ppm). Even though REE concentrations are low, the absence of mineralogical control on their distribution allows for direct chemical treatment without necessity for physical pre-concentration techniques. Given the above, in at least the case of material examined here, umbers can be considered as a formation of potential economic interest for the recovery of REE. We report results on simple acid leaching and ion exchange processes. Parameters such as the concentration (0.05M – 1.75 M), nature of the lixiviant (HNO_3, H_2SO_4, HCl, NaCl, $(NH4)_2SO_4$), solid-to-liquid ratio (1:1 to 1:100) and time of reaction are tested. Optimum experimental conditions yield a recovery > 80% of the initial TREO content in the solution of which 31% is La and 30% is Nd. The purification of the pregnant solution with precipitation of a REE concentrate is studied at varying pH conditions (0.85 – 3) by addition of oxalate. Results yield an efficiency > 90% with extremely good separation of REE from other impurities at pH 1.2 – 1.5. These results show that a significant amount of REE can be extracted and concentrated in a few simple steps at low costs from umbers. Potential applications of this treatment include other oxide-based formations (e.g nodules and hydrogenetic crusts) and land-based secondary deposits (red mud, coal residue) as significant potential resource for REE through similar ion-exchange processes with environmentally friendly lixiviants.

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