

MOBILIZATION AND FRACTIONATION OF RARE EARTH ELEMENTS DURING WEATHERING OF CARBONATITES AT EPPAWALA, SRI LANKA

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Owing to the exceptional physical and chemical properties, rare earth elements (REEs) play a significant role in advanced technological applications. Weathered carbonatite complexes are known to contain significant amount of REEs. Understanding migration patterns of REEs during weathering is important when a deposit is evaluated for extraction of REEs. This study was conducted to investigate the mobility and the fractionation patterns of REEs in the weathered phosphate deposits at Eppawala, Sri Lanka. These deposits have been developed as a result of weathering of basement carbonatites. Samples collected from three working phosphate quarry sites were subjected to geochemical analyses on inductively coupled plasma-optical emission spectrometry and inductively coupled plasma-mass spectrometry in order to understand the distribution of major, trace and REEs concentrations. Enrichment of REEs in the weathered zones [total REEs concentration (Σ REEs) 1,097.47 - 10,931.90 mg L⁻¹] is clearly shown with respect to the parent carbonatites (Σ REEs 347.30 - 885.00 mg L⁻¹). (La/Lu)_{cn} ratios of the weathered zones (28.94 - 63.13) are higher than those of the fresh carbonatites (13.89 - 17.67). It indicates the fractionation of La and Lu during the weathering as a result of differential mobility with solution complexes. REEs are positively correlated with Fe₂O₃ and P₂O₅. Hence, secondary iron oxide and phosphate minerals can be the major hosts for REEs. Mass balance equations further describe the total dissolution of carbonates and formation of secondary phosphates, aluminophosphates and clay minerals which could act as scavenging phases for REEs. The pH values of the weathered carbonatite samples are in the range of 5.24 - 6.97 suggesting that the apatite dissolution process be incomplete. Variation of anomalies of REEs of the main quarry deemed to be highly heterogeneous, which can be attributed to the mixing of weathered materials under the karst conditions. Elevated values of REEs are reported at the leached zone exposed at the hillock area located at the centre of the main quarry site while the lateritic zone shows depleted levels of REEs as a result of intense weathering and leaching. Hence, the intermediate leached zone can be utilized for the extraction of REEs.

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