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Local Concentration of Middle and Heavy Rare Earth Elements in the Col on the Weathered Crust Elution-Deposited Rare Earth Ores

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Abstract

This present study focused on investigating the content and relative enrichment multiple of rare earth elements (REEs) in different terrain of weathered ore body, and the value of light rare earth elements/middle and heavy rare earth elements (LREEs/HREEs), in order to understand the mobilization and redistribution of HREEs. Furthermore, the abrasion pH was investigated as well. The results have shown that the average contents of HREEs in the knap, ridge and col were 37.26, 61.71, and 271.3 μg/g, respectively. The value of LREEs/HREEs was decreased from 16.78 to 7.914 between knap and col and the relative enrichment multiple of HREEs was as follows: $C_{Col\text{-}HREEs} > C_{Ridge\text{-}HREEs} > 0$. It is indicated the HREEs is concentrated in the col and the enrichment degree of HREEs is stronger than the ridge and the knap. Rare earth elements fractionation is exhibited in the different terrain of weathered ore body. Based on this study, the finding that HREEs concentrated in the lower terrain of weathered crust elution-deposited rare earth ores, such as in the col, would become a marker or indicator to search for middle and heavy rare earth enriched zone.

Keywords: Weathered crust elution-deposited rare earth ores; Topography conditions; Middle and heavy rare earth elements; Local concentration

1. Introduction

Rare earth ores are special rare earth resources in the world, which have drawn global attention[1]. The rare earth ores include mineral-type rare earth ores and weathered crust elution-deposited rare earth ores [2]. The weathered crust elution-deposited rare earth ores were widely distributed in the area of mid to low latitude around the southern and northern hemisphere, such as south China, Brazil, Chile, Burma, Thailand, Malaysia, etc[3]. The minerogenic and volcanic rock containing rare earth minerals were weathered into clay minerals through biological and chemical processes under hot and damp climatic conditions. Meanwhile, some rare earth minerals in the original rocks, such as bastnaesite and gadolinite, are easily dissociated as hydrated or hydroxyl hydrated rare earth ions absorbed on the clay minerals [3], which was different with different mineral-type rare earth. The chemical leaching technology is the only method for extraction of rare earth elements. The leaching chemical reaction with an ammonium salt could be written as [4]:

$$[Al_4(Si_4O_{10})(OH)_8]_m \cdot nRE^{3+}_{(s)} + 3nNH^{+}_{4(aq)} \rightleftharpoons [Al_4(Si_4O_{10})(OH)_8]_m \cdot 3n[NH^{+}_{4(s)}] + nRE^{3+}_{(aq)}$$

Where s and aq represent the solid phase and aqueous phase, respectively.

The rare earth elements can be divided into two groups: the light rare earth elements (LREEs) and the middle and heavy rare earths elements (HREEs). LREEs are lanthanum to europium, while HREEs

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