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REE Geochemical Characteristics of Two Granite-Derived Weathering Profiles, Guangxi, South China: Implications for the Formation of the Ion Adsorption Type REE Deposit

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Laterite crusts derived from granite rocks have been well documented because of its economical significance of hosting the ion adsorption type REE Deposit in South China (Wu et al., 1988; Bao et al., 2008; Yuan et al., 2012; Wang et al., 2013). Besides Jiangxi and Guangdong provinces, Guangxi province is regarded as another potential region for exploration and prospecting of the ion adsorption type REE Deposit, where there are at least 67 places of granite-derived weathering crusts have been found bearing the REE mineralization (Gao et al., 2009; Deng et al., 2011). However, the geological and geochemical characteristics of the REE-rich laterite crusts over the granite rocks in Guangxi province have not been fully studied.

The present study deals with two newly discovered granite-derived weathering profiles located in Xiaoping Mountain, Yulin, Guangxi. We present a preliminary evaluation of our new data about REE geochemistry, which provide a detailed information about the REE-rich laterite crusts in Guangxi. Also, our work is useful for the future exploration of REE resources in this region.

There are two types of granite rocks outcropping in the study area, comprising the fine-grained biotite adamellite (A type) and the coarse-grained biotite adamellite (B type). Both of them show similar weathering feathers. From the bedrock upward, three lithostratigraphic layers can be divided based on the variations in color, texture and mineralogy, and they can be termed as the surface soil layer, full-weathered layer and semi-weathered layer respectively. Geochemical analysis show that there are some marked differences in REE geochemistry between the laterite profiles derived from above mentioned two types bedrock.

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As for the laterite profile derived from the fine-grained biotite adamellite (A profile), there are various ΣREE contents along the profile showing as: 132ppm (mean value in the bedrock) →203ppm (mean value in the semi-weathered layer) →180ppm (mean value in the full-weathered layer) →178ppm (mean value in the topsoil). There is a weak enrichment of REE in the full-weathered and semi-weathered layers with a enrichment factor between 1.4-1.5 comparative to the bedrock, and the highest value presents at 226ppm in the full-weathered layer. ΣLREE/ΣHREE throughout the weathering profile is ranging from 1.04 to 1.38.

As for the laterite profile derived from the coarse-grained biotite adamellite (B profile), the variation of ΣREE is showing as: 342ppm (mean value in the bedrock) →569ppm (mean value in the semi-weathered layer) →474ppm (mean value in the full-weathered layer) →375ppm (mean value in the topsoil). REE is largely enriched in the full-weathered and semi-weathered layers, which is 1.4-1.7 times higher than that of the bedrock, and the highest REE value presents at 871ppm in the full-weathered layer. ΣLREE/ΣHREE in the weathering products are ranging from 1.10 to 5.74, indicating that LREE content is greatly higher than HREE in this weathering profile.

Experimental analyses show that the vertical distribution of REE in both A and B profiles are closely related to soil pH and organic matter. The pH value shows a stable increasing trend from top to bottom with a range of 5.22-6.58 in A profile and a range of 4.90-6.58 in B profile respectively. The organic matter content show a decreasing trend from top to bottom, which is conversed comparing with the pH value, with a range of 4.89%-0.63% in A profile and a range of 14.32%-0.62% in B profile respectively. The positions of REE enrichment segments in both profiles are linked to the increasing soil pH and decreasing organic matter.

Previous studies have proposed that the bedrock is a crucial factor for the formation of the ion adsorption REE deposit (Huang et al., 1988; Bai et al., 1989; Hua et al., 2007; Wang et al., 2013). By comparative studying on the laterite profiles over different bedrocks but under similar supergene environment, it can provide some valuable information about the influence of the bedrock to the formation of the ion adsorption REE deposit. Our works reveal that the bedrock in A profile is a REE-poor type (132ppm) in the granite rocks, and the highest ΣREE of its weathering products is only 226ppm with an enrichment factor of 1.7. However, the bedrock in B profile is a relative REE-rich type (274ppm), and the highest ΣREE of its weathering products is up to 871ppm with an enrichment factor of 3.7.

From the above comparison, We confirm that the initial ΣREE of the bedrock has a fundamental impact on the supergene enrichment of REE in the weathering crust. This rule is very common in other granite-derived weathering crusts in Guangxi. For example, the biotite granite with 323ppm ΣREE can form a product with 980ppm ΣREE by weathering in Huashan region, Hezhou, and the volcanic rocks with 463ppm ΣREE can form a product with 2290 ppm ΣREE by weathering in Liutang region, Chongzuo, etc.

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