

Fractionation between LREE and HREE in granitic rocks in southern Myanmar: Implications for HREE-rich granite

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As crustal abundances of heavy rare earth elements (HREE) except yttrium (Y) are generally smaller than those of light rare earth elements (LREE), HREE are more expensive than LREE in the market. At the present day, minable HREE-rich deposits are confined almost exclusively to ion-adsorption type deposits (e.g., Longnan in China), underlain by highly-differentiated (> 74 -75 % SiO₂) calcalkaline granites which are enriched in HREE and depleted in LREE. In this study, we collected granitic rocks of 67 -76 % SiO₂ in southern Myanmar to discuss characteristics of HREE-rich granites based on whole-rock geochemistry and the occurrence of REE-bearing minerals.

Alkaline rocks, formed by magma with a low degree of partial melting, are significantly enriched in LREE and are weakly enriched in HREE because LREE are more incompatible than HREE in magma because of their larger ionic radii. Fractionation of REE-bearing minerals by magmatic differentiation has an important role for the formation of HREE-rich granite rather than the degree of partial melting. In our study, Late Cretaceous to Eocene granitic rocks in southern Myanmar were analyzed and geochemical results indicated that differentiated granites over the approximate boundary of 74 % SiO₂ tend to be enriched in HREE. This boundary is more distinctly decided by the occurrence of REE-bearing than by the whole-rock chemical composition. Granitic rocks less than 74 % SiO₂ contain either or both of titanite and allanite, whereas granites over 74 % SiO₂ rarely contain these minerals. In this study, results of the EPMA analysis indicated that some titanite crystals are rich in HREE. Because titanite is the dominant HREE-bearing mineral as much as zircon in granites, undersaturation of titanite may lead to HREE-rich melt eventually. In the strongly-differentiated granites over 74 % SiO₂, titanite was rarely found and a variety of HREE-bearing minerals such as synchysite-(Y) were observed.

This study result suggests that the HREE-rich granites, as represented by parent rocks underlying ion-adsorption type deposits, were potentially formed by magmatic differentiation under the condition of titanite-undersaturation. Whole-rock chemical compositions of granitic rocks and the occurrence of specific REE-bearing minerals may be indicative of exploration for HREE deposits.

Keywords: HREE, LREE, Granite, Titanite, Allanite, Deposit