Enrichment of REE in weathered crust of Sn-bearing granitic rocks in southern Thailand

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Consumption, and consequently demand, of rare earth elements (REE) is being increased recently in the world due to development of electronic industries, in which middle to heavy REE such as dysprosium (Dy) are required.

Among various type of REE deposits, carbonatite deposits such as the Baiyun Obo deposit, China, have been the major resource of REE, especially for light REE (LREE). Wu et al. (1990) revealed that REE is mostly concentrated in an adsorption state in clay in the weathered crust of granitic rocks at Longnan, southern China, which is now the most significant deposit of HREE. Consequently, China is being the dominant producer both LREE and HREE in the world.

Wu et al. (1990) attributed tropic climate to the development of weathered crust of granitic rocks and to concentration of REE at Longnan. Therefore, similar type of REE resource can be expected in other tropic regions, where granitic rocks are exposed.

REE elements are known to be enriched in the melt during magmatic differentiation, and REE-bearing minerals occurs in pegmatites and as accessory minerals in highly differentiated ilmenite-series granitic rocks (e.g., Ishihara, 1981).

Thailand-Malaysia-western Indonesia has been known as major metallogenic province of Sn associated with S-type ilmenite-series granitic rocks (e.g., Hutchson, 1996). The distribution of granitic rocks of tin field from Thailand through Malaysia to western Indonesia can be divided into three belts, namely, western, central and eastern belts, trending broadly north-south. In Thailand, Sn has been produced from primary deposits such as disseminated, vein-type and skarn deposits associated with S-type ilmenite-series granitic rocks, and from secondary deposits such as placer deposit derived from S-type ilmenite-series granitic rocks, mainly in the western belt such as Phuket and Takua Pa areas (e.g., Hutchson, 1996).

Charusiri et al. (1993) reported that 40Ar/39Ar ages of granitic rocks from western, central and eastern belt range from 80-50 Ma, 220-180 Ma and 245-210 Ma, respectively, and thus, the western granitic belt formed in Late Cretaceous to Paleogene, whereas the central and eastern granitic belt formed in Late Triassic to Middle Jurassic and in Early to Late Triassic, respectively.

Wu and Ishihara (1994) reported that total REE contents of granitic rocks in Thailand range from 21 to 731 ppm. Average total REE content of granitics rocks at Samui island in the central belt is the highest (511 ppm), while average total REE content of granitics rocks at Phuket island in the western belt is the second highest (453 ppm). Hirano et al. (1994) reported that average total REE contents of granitic rocks from western, central and eastern belts in Thailand are 460 ppm, 220 ppm and 390 ppm, respectively.

Pungrassami (1984) revealed that REE including Dy, Eu, Sm and Ce are enriched in the weathered zone compared with those in original granitoids, in S-type granitoids at the Thung Poe and Thung Kamin mines, Songkla, southern Thailand. Likewise, Hirano et al. (1994), Kamioka et al. (1994) and Kamitani et al. (1994) reported that REE are significantly enriched in the weathered crust of granitic rocks in the western granite belt in Thailand in which the original REE contents are high.

Geochemical studies were conducted on the granitic rocks and their weathered crusts in the southern Thailand in order to investigate the ion-adsorption type REE potential. The studied areas include Phuket, Takua Pa, and Ranong Sn fields in southern Thailand. Primary Sn mineralization was associated with granitic rocks belonging mostly to S-type ilmenite-series in the Western Granitoid Belt. Fresh granite, weathered granite and hydrothermally altered granite were collected for this study. In addition, samples of fraction of heavy minerals in stream sediments along narrow channel streams were also collected in some places.