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# Geochemical behavior mechanism of base metal and rare earth elements in water-rock interaction

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Water-rock interaction is devided into high temperature type and low temperature type. Hydrothermal alteration and formation of hydrothermal ore deposits occur in high temperature, while weathering and diagenesis in low temperature. Large number of studies on high temperature water-rock interaction and interpretation of mass transfer mechanism associated with the water-rock interaction have been carried out from experimental and computer simulation works.

For instance, chemical compositions of geothermal water in reservoir in geothermal system were successfuly interpreted in terms of chemical equilibrium model (Shikazono, 1978). However, chemical equilibrium model cannot be applied to chemical composition of hydrothermal solution and precipitating minerals at discharge zone of hydrothermal system and fluid flow - preciitation kinetics coupling model and other complicated models have been used to interpret the characteristics of discharge zone (e.g. Shikazono et al., 2012).

On the other hand, interpretation of mass transfer mechanism in low temperature water-rock interaction process is generally difficult because many factors (dissolution, precipitation, adsorption, deasorption, ion exchange, advection, diffusion) affect the process, although some efforts to elucidate the chemical weathering process of granitic rocks and secondary mineral distribution around ore deposits.

In previous works the geochemical behaviors of major elements (e.g. alkali, alkali earth, Si) associated with water-rock interaction process have been studied, while a few studies on minor elements (base metals, rare earth elements) are available. Therefore, here, the studies on these elements are focused on, and are compared with major elements.

As examples of these studies, the analytical results and interpretations on distribution of base metals and rare earth elements in volcanic soil (andosol, loam) with depth (Kanagawa Pref.), enrichment of rare earth elements in chemical weathering of Japanese and Chinese granitic rocks, base metals, rare earth elements, Cs and Sr behavior in high alkaline ground water-bentonite interaction (Mangatarem, Phillipine), formation process of high alkaline groundwater (Mangatarem, Phillipine) are presented and interpreted based on chemical analytical, experimental (dissolution experiments, step wise extraction experiments) and computer simulations (dissolution kinetics model) results.

Geochemical behaviors of base metals and rare earth elements in these processes are disscussed in relation to ionic radii, surface complexes and elemental mobilities controlled by these parameters.

Keywords: base metal elements, rare earth elements, water-rock interaction, geochemical behavior mechanism, formation of water quality mechanism, weathering