

Microscopic analyses of weathered granite soil in ion adsorption rare earth ore of China

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Ion adsorption ore existing mainly in southern part of China is important as a supply source of rare earth elements (REE). The ore typically contains more than 50 % of ion-exchangeable REE that can be extractable with electrolyte solution such as (NH₄)₂SO₄ solution. It has been estimated that clay minerals, particularly kaolinite, are adsorbing REE in the ore. However, the direct analyses for the individual minerals have been rarely conducted due to the relatively low concentrations of REE (<2000 ppm). In the present study, we have attempted to clarify the distribution and the chemical state of REE on a submicroscopic scale by using advanced experimental apparatuses. The weathered granite soil analysed in this study was collected from ion adsorption ore in Jiangxi Province, China.

XRD measurements indicated that the weathered granite is mainly composed of quartz, K-feldspar and kaolinite. The results of SEM-EDS and LA-ICP-MS measurements showed that “kaolinitic particle” is abundant with REE compared to the other mineral particles in the ore. XAFS study on the kaolinitic particle suggested that REE are mostly hydrated. STEM-EDS analyses revealed that the kaolinitic particle is composed of kaolinite, illite and hematite. Considering general weathering process, it can be assumed that K-feldspar was altered into illite and further into kaolinite during chemical weathering. Lastly, the detailed distributions of REE in the kaolinitic particle were investigated by elemental mapping using NanoSIMS.