Geochemistry and mineralogy of granite saprolite beneath sedimentary kaolin deposits in the Seto district, central Japan

Haruna Asai[2], *Kikuchi Ryosuke[1], Yoko Ohtomo[1], Tsubasa Otake[1], Tsutomu Sato[1]

1. Division of Sustainable Resources Engineering, Faculty of Engineering, Hokkaido University, 2. Graduate School of Engineering, Hokkaido University

Kaolin is a ubiquitous clay mineral in the Earth's surface and an important non-metallic mineral resource used for ceramics, refractory materials and fillers. In recent years, it has been concerned the local exhaustion of kaolin ores in the sedimentary kaolin deposits in the Seto and Tono district, central Japan, which are the largest source in Japan. The use of kaolin-rich saprolite, which corresponds to granite weathering crusts beneath the lower part of the Seto Porcelain Clay Formation (SPCF), as an alternative resource is under consideration. Furthermore, as the distribution of kaolinic saprolite is closely related to that of the SPCF, it is also of interest for estimating the kaolinization process in this area.
Samples were collected from an active mine in the northern part of Seto district, Aichi Prefecture, from SPCF containing Kibushi-clay (ligneous kaolin ores) and Gaerome-clay (kaolin ore containing coarse quartz gravels), and the kaolinitic saprolite layers beneath SPCF, respectively. The bulk samples and clay fractions were examined for major elements and mineral compositions by using XRF, powder XRD, SEM and TEM, as well as for trace element compositions by ICP-MS after pressurized acid digestion.
The saprolite samples showed a tendency for more granite-derived feldspar and biotite to remain at greater depths. SEM and TEM observations demonstrated two forms of kaolinite: the fine-grained kaolinite common to that in the SPCF and coarse-grained kaolinite originated from biotite. The former exhibited spindle-shaped particles (~100 nm length and several tens of nm width), whereas the latter showed a platy form of several hundreds of μm length and mixed layer structures of kaolinite and weathered biotite. The mobilities of major elements showed predominant leaching for most of the elements, throughout the SPCF and saprolite layers. Undesirable elements for industrial uses, such as iron, were not increased due to the transportation from the SPCF, but rather due to the residual minerals in the original basement granite. Their immobile elements (Zr, Hf, Nb, Ta) suggest that both the SCPF and saprolite layers derived from the Inagawa granitoids (Ryoke zone) rather than the adjacent Naegi-Agematsu granite (Sanyo zone) on the geological map.

Keywords: clay, kaolin, TEM, Trace elements

