

A study of Cs-adsorption behavior of clay minerals using autoradiography and considering the actual environments

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Though there are a number of studies to analyze the soil contamination with radioactive cesium released from Fukushima nuclear accident, microscopic analyses to investigate, for example, the adsorption sites of radioactive cesium in the actual soil are few. Recently we found, using autoradiography with special imaging plates (IPs) and various electron microscopic techniques, that weathered biotite originated from Abukuma granite in Fukushima is a major adsorbent in the soil collected from Iitate village (Mukai et al., 2014). On the other hand, the adsorption experiments performed in the laboratory to determine the Cs-adsorption ability of various clay minerals indicated that weathered biotite or vermiculite did not distinctively adsorb Cs, compared to the other clay minerals, even at similar contamination level to that in Fukushima (e.g., <http://reads.nims.go.jp/>). This discrepancy suggested that actual adsorption of Cs in the soil was controlled by kinetics among multi-minerals and solution, rather than by simple equilibrium between mono-mineral and solution. Moreover, Cs adsorption experiments to minerals should be performed at a sub-ppm level in the minerals, employing the actual soil in Fukushima. Considering these ideas, we conducted a new Cs-adsorption experiment, in which various clay minerals were immersed together in dilute Cs-137 radioisotope solutions and the amount of Cs-137 adsorbed in each mineral was measured by autoradiography using an IP. It was found that a large quantity of Cs-137 predominantly fixed by the weathered biotite collected in Fukushima, compared to those by the neighboring clay minerals (unweathered biotite, illite, montmorillonite, kaolinite, halloysite, allophan, imogolite, etc.). Moreover, it was also observed that, with the increase of the immersion time, Cs-137 initially adsorbed in the other clay minerals moved to weather biotite, indicating that mineral species fixing the Cs-137 were changing with time. This phenomenon might be related to the fixation of radioactive cesium in the soil of Fukushima, which was reported recently.

Keywords: Fukushima nuclear accident, radioactive cesium, clay minerals, weathered biotite, adsorption, autoradiography