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Distribution of radioactive cesium in contaminated Fukushima soil particles using FIB and IP autoradiography

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Recently radioactive particles in the contaminated soil collected from Fukushima have been specified by imaging plate (IP) autoradiography and characterized using electron and X-ray microanalyses (Mukai et al., 2014). These particles are several tens of micrometers in size and, in the next step, it is of importance that how radioactive cesium is distributed in the particles to discuss the states and dynamics of Cs in the soil. For this purpose, IP autoradiography itself is no longer useless because its spatial resolution is around a few hundred of micrometers at best. To overcome this limitation, we successfully applied micro-processing using the focused ion beam (FIB) technique along with IP autoradiography.

According to the results by Mukai et al. (2014), three types of the radioactive soil particles: (1) weathered biotite, (2) organic particle containing fine mineral particulate, and (3) aggregate of fine clay minerals, were investigated. The weathered biotite with plate-like morphology was divided into small pieces of a few micrometers using FIB and they were separated to be distinguished by IP autoradiography, using a micromanipulator. The autoradiography detected radiation from all pieces, indicating that radioactive cesium is distributed rather homogeneously in the biotite. Probably a solution containing radioactive cesium penetrated inside the crystal, through dense cleavage spaces which are well developed in the weathered biotite. On the other hand, one or two of several pieces from the organic particle were radioactive, meaning that the cesium is localized in the particle, probably at the mineral particulates and/or organic matter in the particles. Finally, the aggregate of clay minerals were crushed and spread on IP using the micromanipulator. Most fragments were radioactive, suggesting that the cesium is widely distributed in the aggregate.

Keywords: Weathered biotite, Fukushima nuclear accident, Radioactive cesium, Autoradiography, FIB