Characterization of radiocesium-bearing microparticles deposited and resuspended in Fukushima

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The accident at Fukushima Daiichi nuclear power plant caused contamination by radionuclides over northeast Japan. Radiocesium was deposited on the ground in both soluble and insoluble forms. Radiocesium deposited in soluble form was mainly adsorbed on clay minerals such as weathered micas in soil. On the other hand, imaging plate (IP) autoradiography of the contaminated materials such as plant tissues showed scattered distribution of intense radioactive spots, suggesting the presence of microparticles accumulating radionuclides. In general, radioactive microparticles have stronger radioactivity than clay minerals contaminated by soluble radiocesium. In order to understand and predict the fate of radioactive materials contaminating the terrestrial environment, it is important to clarify the physicochemical properties of those materials. The purpose of this study is to evaluate the structures and properties of radioactive microparticles found in Fukushima.

Radioactive microparticles deposited on plant leaves and air-dust filters were taken from Fukushima in 2011, 2013 and 2015. The shape, internal structure, composition and elemental distribution of the radioactive microparticles were analyzed by SR-XRF, SEM and TEM/STEM. The microparticles were 0.5–2.5 μm in diameter and contained 0.5–5 Bq of ^{137}Cs per particle. O, Si, K, Cl, Fe, Zn were detected in addition to fission products including Rb, Sn, Cs. Electron diffraction showed that the main body of the microparticles was amorphous, namely silicate glass. A few nanoparticles such as Cu, Zn, Mo-sulfide were occasionally occluded in the microparticles. Elemental distribution in the radioactive microparticles was different among the microparticles, possibly depending on the forming process and weathering in the field. Approximately 10% of ^{137}Cs was leached from the microparticles in water at 60°C for 2 weeks, suggesting that the microparticles are subjected to weathering and release radiocesim in soluble form.