Migration of radionuclides in land-surface in Fukushima: mechanisms of secondary transport

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Radionuclides such as radiocesium and radioiodine were emitted from the Fukushima Daiichi Nuclear Power Plant (FDNPP) accident. They were mainly transported via. atmosphere and deposited on land-surface as wet or dry deposition [1]. After the deposition, they have migrated in the terrestrial environment depending on their chemical properties and interactions with various components in the soil, sediment, and water. The initial distribution has been extensively studied by the measurement of radioactivities in soil collected from various areas and by numerical models of the disperson by air [1]. In this presentation, we focus on the re-distributions of radiocesium and radioiodine in land-surface in Fukushima. The processes include (i) secondary migration of soil particles containing radionuclides by wind and (ii) transport by water in soil, river water, and sediments in Fukushima. In particular, the process (ii) has been studied coupled with their speciation that should be important to understand their behaviors in the surface environment.

After the deposition of radiocesium, its vertical profiles in soil in Fukushima showed that most of radiocesium have been retained at the very surface (i.e., < 5 cm) of the soil. Leaching experiment showed that radiocesium is strongly bound to soil particles. Size distribution analyses for particulate matters and sediment particles in rivers showed that radiocesium is enriched in finer particle fractions, suggesting that radiocesium has a high affinity for clay minerals. This suggestion was confirmed by the speciation analysis using X-ray absorption fine structure (XAFS) showing that radiocesium forms inner-sphere complex within the interlayer of 2:1 phyllosilicate. These results can explain the increase of radiocesim in river sediments in basin and in estuary areas by the secondary transport.

Leaching-precipitation behavior of radioiodine from soil samples suggets that iodine was incporporated into humic substances. The formation of organic iodine has been suggested by XAFS, which can proceed in a relatively short period, such as within a week or a month. Formation of organoiodine is responsible for the relative immobile nature of radioiodine in the soil layer.

[1] N. Yoshida and Y. Takahashi, *Elements* **8**, 201-206, 2012.