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福島第一原発周辺で採取した土壌から分離した放射性微粒子の同定
Identification of radioactive microparticles in the vicinity of the Fukushima Dai-ichi Nuclear Power Plant

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The Fukushima Dai-ichi Nuclear Power Plant (FDNPP) disaster in 2011 discharged a large amount of radionuclides to the environment. Previous studies already disclosed the source term and inventory of radionuclides. However, physical and chemical states of radionuclides in the environment have yet to be revealed. Numerous environmental samples have been analyzed to investigate distribution of radionuclides by digital autoradiography using an imaging plate (IP). These studies pointed out that the spot-type contaminations were appeared and very common not only for the samples collected during the early stage (collecting until April 2011) of the FDNPP disaster but also for those collected later. In the FDNPP disaster, major forms of radioactive materials have been assumed to be gaseous. This is because the disaster underwent no reactor explosion nor fire of the reactor core, which is quite different from the situation in the Chernobyl NPP (ChNPP) disaster in 1986. In addition, it has been revealed that the emitted nuclear fuel (uranium) and 90Sr was very low. Therefore, elucidation of the cause of the spot-type contamination is crucial, which could contribute to know about physical and chemical state of radionuclides in the environment, as well as disclose their release processes from the FDNPP. Present study thus aiming at elucidation what makes the spot-type contamination in the IP analysis.

Surface soil samples were collected in the area about 20 km northwest from the FDNPP in June 2013. Spot-type contaminations were detected by IP analysis. Then, the radioactive particles were isolated by repeated sorting process and measured by the γ-spectroscopy with the high purity germanium semiconductor detector. The particles isolated were finally observed by SEM-EDS to determine the elemental composition and the morphology.

So far identified are four particles, and determined radionuclides by γ-spectroscopy were ^{134}Cs and ^{137}Cs. The morphology of the particles exhibited two types; spherical and fragmental. Thus, the spot-type contamination was characterized as due to such specific radioactive particles. The particles consist of Si, O, Zn, Fe, etc. and Cs (of which activity matched with the results by γ-spectroscopy) were also easily detected by SEM-EDS, suggesting glassy molten material. However, other fission products were not found in the particles. Tremendous amount of radioactive particles were collected around the ChNPP, and they were termed hot particle. Dominant components of the hot particle are nuclear fuel and typical fission products such as ^{90}Sr, ^{153}Eu as well as ^{134}Cs and ^{137}Cs. In contrast elemental composition of the present particles were dominated by Si. Uranium was found for only one of the present particles, but its concentration was very low and localized within the particle. In conclusion, characteristics of the present particles are quite different from the Chernobyl hot particles, but very similar to those reported for the particles isolated from HV filter samples in Tsukuba (Adachi et al., 2013, Abe et al., 2014).

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