Geophysical Research Abstracts
Vol. 16, EGU2014-10119, 2014
EGU General Assembly 2014

Activity ratios in soil contaminated by the source of different reactor condition in the FDNPP accident

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The Fukushima Dai-ichi Nuclear power plant (FDNPP) accident caused radioactive contamination on the surface soil at Fukushima and its adjacent prefectures. Substantial contamination has been found in the northwestern area from the FDNPP, according to the airborne monitoring and ground base survey by the Japanese government. Activity ratios would have characteristic information on emission sources because each relevant reactor had different amount of radionuclide and different activity ratio. The ratios can be used to clarify more detailed source and process in the contamination. We have addressed to consider them in Namie town, northwestern region from the FDNPP.

This study focused on the gamma-ray emitting radionuclides of ^{134}Cs, ^{137}Cs, and ^{110m}Ag. The activities were decay-corrected as of 11th March, 2011 when all nuclear reactors scrammed. Data of activity ratios by our results and the Japanese official report classified the investigated northwestern region into 3 groups. Ratios of 0.02 for ^{110m}Ag/^{137}Cs and 0.90 for ^{134}Cs/^{137}Cs were observed in the northern region of 15 km inside from the FDNPP. On the other hand, two kinds of ^{110m}Ag/^{137}Cs ratios of 0.005 and 0.002 were distributed broadly in the region 60 km away from the plant. The ^{134}Cs/^{137}Cs ratio was 0.98 there.

The activity ratios of ^{110m}Ag/^{137}Cs and ^{134}Cs/^{137}Cs in the northern region from the FDNPP correspond to those of nuclear fuel in Unit 1 according to estimation using the ORIGEN code. The ^{134}Cs/^{137}Cs in the northwestern area from FDNPP agrees with that of Unit 2 and 3. The ^{110m}Ag/^{137}Cs ratios of 0.005 and0.002 are 1/5 $-$ 1/10 of the Unit 2 and 3. Official report has announced that discharges of the radionuclides from Unit 2 and 3 occurred on 14th March, 2011. It is known that contamination in the northwestern region from the FDNPP took place on 15th March, 2011. Plausible species for silver in reactor core, metal, and halide etc. have higher boiling point than those species for cesium. The core would be cooled down to lower temperature of the boiling point of silver at the timing contamination occurred. Thus, silver with higher boiling point was not much released than cesium with lower boiling point. The ^{110m}Ag/^{137}Cs ratio has served to identify the specific sources of contamination in the northwestern area from the FDNPP.