Radioactivity and its environmental behavior in soil samples collected from Fukushima prefecture

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The accident of Fukushima Daiichi Nuclear Power Station at the Northeast Japan Great Earthquake in 2011 released a large amount of radioactivity into the environment. Those radioactivities spread and transferred into the surrounding environment including food, soil, water and even human bodies. Here, the topographic feature of Fukushima Prefecture represented as two natural terrain-barriers of the Abukuma mountains and Ou mountain ranges connected to the north and south is not only divided the area into three regions, Aizu Chiho (west area), Naka Dori (middle area), Hama Dori (Pacific sea of coastal side) but also affect the spreading processes of radioactive species.

Radioactivies released into the atmosphere are spread by the wind, and eventually removed from the atmosphere. At the depositing on the earth's surface, the amount of deposition is largely controlled by rain falls since cesium is likely to exist as small particles (dusts) in the atmosphere. A high radioactive area with concentrated such Cs is generally called as "hotspot." According to a computer simulation immediately after the accident, the large amount of deposition is calculated in the areas below: eastern part of Fukushima Prefecture, southern part of Miyagi Prefecture, northern and western parts of Kanto district. In those area, unfortunate precipitation coincided with wind transportation of radioactive spices. In this study, radiation dose and ^{137}Cs concentration were measured by NaI(Tl) scintillator (radioactivity analyzer) for soils and water samples from 6 sites of 2 cities in Fukushima Prefecture: Kitakata City and Iwaki City. Moreover, simultaneous multi-elements analysis by ICP-OES was performed for alkaline elements, coupled with confirmation by measurement of ^{133}Cs as stable isotope using ICP-MS. The isotope ratios between radioactive ^{137}Cs and stable ^{133}Cs were calculated from both of the concentrations of ^{137}Cs and ^{133}Cs. As a result, the abundance of the metals basically does not depend on the distance from the Fukushima Daiichi Nuclear Power Plant, within small variation among the sampling sites. ^{137}Cs/^{133}Cs in Kitakata City showed higher values compared to those in Iwaki City. It suggests that the decontamination carried out in Iwaki city may contribute as well as the higher inherent concentration of ^{133}Cs in Iwaki City. Moreover, such site intrinsic isotopic ratios between radioactive and stable isotopes seems to have a potential for identification of the origin of the un-located samples in future.

The correlation between Cs and other metals was also examined: K as alkali metal group and Ba as alkaline earth metal. There is a correlation between K with Cs, as in the same metal group elements. Here, concentration of Ba also correlates with stable ^{133}Cs, which resulted in the anti-correlation with radioactive ^{137}Cs. It may also resulted from the decay production from ^{134}Cs into Ba.

Keywords: environmental behavior, Isotope, enviroment radioactivation

