Formation mechanism of radiocesium concentration in throughfall in a cedar forest

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The Fukushima Daiichi nuclear accident (FDNPP) in 2011 released large amounts of radioactive material into the atmosphere. In particular, ^{137}Cs which has a long-half-life of 30.17 years will be a radiation source in the long term, thus it is necessary to clarify its dynamics in the environment. It was estimated that approximately 70% of radiocesium deposited on land is accumulated in forests. Therefore, it is important to understand the dynamics in forest environment. The most of radiocesium deposited on forests, especially evergreen conifer forest, was intercepted by the forest canopy. After that, it is known that the intercepted radiocesium will be transported from canopy to forest floor in association with rainfall leaching and litterfall.

The major pathway of radiocesium dynamic from canopy to forest floor peculiarly during the early the accident is throughfall, but the concentration of radiocesium in throughfall exponentially decreased with time. However, recently the trend that the reduction rate of the concentration of radiocesium in throughfall slowed down, it is necessary to monitor the radiocesium dynamics as a long-term input pathway to forest floor. In addition, it has been confirmed that the radiocesium concentration in throughfall varies greatly depending on the canopy cover and seasons and rainfall events. Therefore, it may be useful to clarify the elution mechanism of atmospheric deposit from forest canopy into rainwater. In this study, we investigated the formation mechanism of radiocesium concentration in throughfall of a cedar forest in Namie Town, Fukushima Prefecture. Using a rainwater sampler installed inside and outside the forest, rainfall over the canopy (12 locations) and rain outside the forest (3 locations) were collected, and the rainfall and radiocesium concentration were quantified. Based on these observations, we analyzed the spatial distribution characteristics of throughfall and the fluctuation factors of radiocesium concentration. It is considered that the fluctuation of radiocesium concentration is affected not only by the time since the accident but also by the difference between each rainfall event and the spatial variation.

The correlation between the canopy rainfall and the openness of the upper part of the sampler indicated that the canopy structure affected the rainfall distribution under the cedar canopy. In addition, the canopy passage rate of rainwater showed a tendency to increase with the event rainfall. Since the radiocesium concentration in the throughfall tends to decrease with increasing the amount of throughfall, it is highly possible that the effect of dilution with the increase in rainfall is working. The radiocesium migration flux showed a tendency to increase with increasing canopy rainfall per stand. However, observations with small transition flux have been obtained even when the event rainfall is relatively large. The formation of radiocesium is affected by the amount of rainfall, but the trend is changed by the difference of the interception process in canopy and spatial distribution of throughfall due to differences in rainfall characteristics, and it is suggested that it may affect the amount of radiocesium dynamics.

Keywords: Throughfall, Radiocesium, Interception by forest canopy, monitoring

