Temporal changes in the vertical distributions of Cs-137 in forest roots

*Junko Takahashi[1], Takuya Sasaki[1], Yuichi Onda[1]

1. Center for Research in Isotopes and Environmental Dynamics, University of Tsukuba

In 2011, large amount of radionuclides was released into the environment by the Fukushima Daiichi Nuclear Power Plant accident. In forests where decontamination is not planned, it is expected that ^{137}Cs will circulate and remain for the long term, so understanding the behavior of ^{137}Cs in forest soil is important in the future. Since the accident, it has been reported that the distribution of ^{137}Cs in Fukushima forest soil has shifted downward over time. Hihara(2019) found that the contribution by rainfall infiltration water was less than 10% of the downward migration of 137Cs in forest soil (mature cedar) in Fukushima Prefecture (August 2018 to July 2018). Therefore, this study focused on the roots of forest plants as one of the factors of downward migration, and estimated the Transfer Factor (T.F. = ^{137}Cs concentration in root / ^{137}Cs concentration in soil) for each depth to determine the effect.

Soil was collected from a mixed forest and a younger cedar forest (440-450 kBq m^{-2} estimated by aircraft monitoring) in the Yamakiya district of Kawamata-town, Fukushima Prefecture using a scraper plate. The sampling intervals were 0.5 cm for a depth of 0-5 cm, 1 cm for a depth of 5-10 cm, and 5 cm for a depth of 10-20 cm. The collected sample was dried and assed through a 2 mm sieve to measure the ^{137}Cs concentration. In addition, the roots were separated by tweezers at the time of sieving soil, the surface particles were washed away using ultrasonic waves, and divided into three based on the diameter VF < 0.5 mm < F < 2.0 mm < M), and then the ^{137}Cs concentration was measured with a Ge semiconductor detector.

As results, the weight average of 137Cs concentrations in root at each soil depth were 0.16-6.99 [Bq / g] in 2012, 0.44-17.81 [Bq / g] in 2015, and 1.55-30.76 [Bq / g] in 2017 for mixed forest, and these in younger ceder forest were 0.02-1.18 [Bq / g] in 2012, 0.050-3.56 [Bq / g] in 2015, and 0.21-3.49 [Bq / g] in 2017. In addition, at this stage, no clear tendency of ^{137}Cs concentration in the different root diameter was found.

In both forests, the T.F. tended to be higher at the deeper depth in each year. The reason for the difference in the transfer coefficient for each depth is considered to be the difference in root absorption ability, the difference in the exchanged amount of ^{137}Cs in soil, and the movement of ^{137}Cs in the plant body (translocation) for each depth. In particular, the Transfer Factor is greater than 1 at the depth of 10-20 cm, indicating that translocation has occurred. If the roots detach and decompose at each depth, this result suggests that root absorption influences the downward migration of ^{137}Cs in soil.

Keywords: FDNPP accident, Forest soil, Transfer factor, Radiocesium

