1–12 How is Radiocesium Distributed in a Town?

— Investigation of the Radiocesium Distribution in Residential Areas —

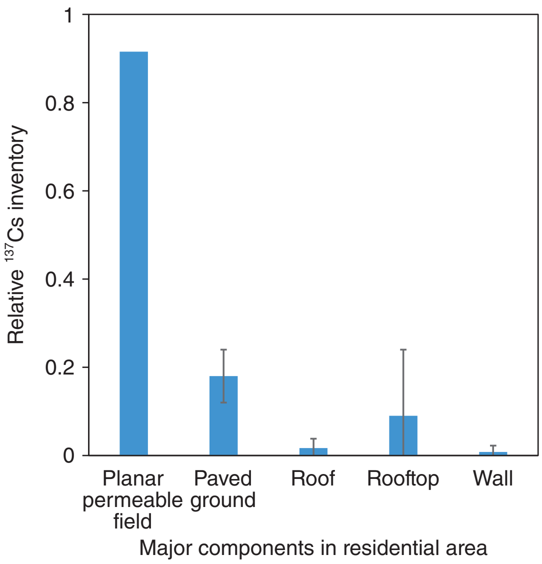

Fig.1-28 Relative ^{137}Cs inventory on studied components in urban areas during January 13–23, 2015
The error bar indicates the standard deviation of the relative ^{137}Cs inventory. Residential-area-specific components such as paved ground, roofs, and walls showed obviously lower ^{137}Cs-relative inventories than planar permeable fields in January 2015.

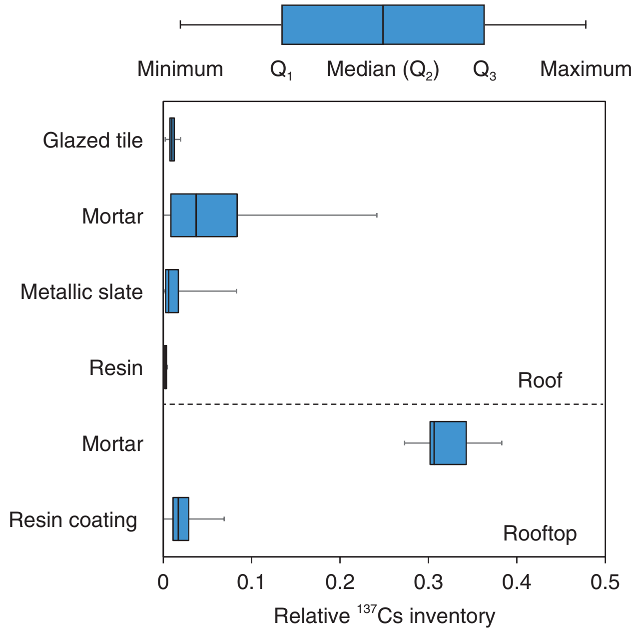

Fig.1-29 Box-and-whisker plot of the relative ^{137}Cs inventory for surface materials of roofs and rooftops
The relative ^{137}Cs inventory varied largely among the materials of roofs and rooftops. Porous materials, such as mortar, showed significantly higher relative ^{137}Cs inventories than others, and glazed tile and metallic slate showed obviously smaller values, indicating that ^{137}Cs deposited on smooth materials were easily removed from the surface during the first four years after the accident.

The distribution and migration of radiocesium in diverse terrestrial environments has been well-studied; however, there has been little analysis of its behavior in residential areas. Since residential areas comprise diverse components such as paved ground, roofs, walls, and permeable ground, the radiocesium dynamics should be different from other terrestrial environments. To evaluate the dynamics of radiocesium in a residential area, ^{137}Cs inventories (activity per unit area) were measured on major components (i.e., roofs, rooftops, walls, planar permeable fields, and paved ground) for 11 building lots in the evacuation zone in January 2015. The ^{137}Cs inventories were converted to relative ^{137}Cs inventories, which are defined as the relative values of the ^{137}Cs inventory on each component to the initial ^{137}Cs inventory on a nearby planar permeable field, enabling comparison of ^{137}Cs inventories among sites with different initial deposition amounts. The initial ^{137}Cs inventory on planar permeable fields on March 23, 2011 was estimated by only physical-decay correction, since the ^{137}Cs inventory on planar permeable fields has been reported to decrease almost as predicted by its physical-decay constant, without any detectable wash-off effects.

The average relative ^{137}Cs inventories on the components are shown in Fig.1-28. The value on paved ground accounted for about 20 % of that on the planar permeable field. Other components, such as roofs, rooftops, and walls also showed values less than 10 % of that on the planar permeable field. This study was carried out in the evacuation zone in which decontamination had not been conducted. Therefore, these results indicate that large amounts of radiocesium deposited in the residential area were removed by initial run-off and the following wash-off effects due to rainfall over the four years following the accident, even without decontamination.

The average relative ^{137}Cs inventories on roofs and rooftops showed large coefficients of variation over 100 %. Studies in Europe reported that porous materials such as unglazed tiles have larger absorption capacities for ^{137}Cs than other materials. Variations in the relative ^{137}Cs inventories depending on roof and rooftop materials were also observed in this study (Fig.1-29); smooth-surface materials such as glazed tile, metallic slate, and resin showed low relative ^{137}Cs inventories, while unglazed mortar showed large values. Since the roof and rooftop are major components in residential areas, these results indicate that the migration of radiocesium deposited in the area largely depended upon the materials of roofs and rooftops.

The results in this study are expected to contribute to decontamination planning and exposure-dose simulations in residential areas.

Reference

Yoshimura, K. et al., Distribution of ^{137}Cs on Components in Urban Area Four Years after the Fukushima Dai-Ichi Nuclear Power Plant Accident, Journal of Environmental Radioactivity, vols.178–179, 2017, p.48–54.