

Seasonal change and formation factors of dissolved radiocesium concentration in a headwater catchment after the Fukushima Dai-ichi Nuclear Power Plant accident

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Nine years after the Fukushima Daiichi Nuclear Power Plant accident, the presence of radioactive cesium is still a problem in forests and uncontaminated evacuation areas, and evaluating its behavior is an important issue in resident return and industrial rehabilitation. It has been reported that the radiocesium migration behavior changes with time, and that the cesium concentration of river water shows an exponential decreasing trend with time, but the mechanism has not been fully elucidated yet. Particularly in the forest basin at the headwater areas, the concentration of dissolved cesium in stream water may be maintained high due to leach from organic materials such as litter and mixing with soil water. In this study, we set up a test basin for a forest basin at the headwater catchment located in a high deposition area in Namie city, Fukushima Prefecture, Japan and investigated components that contribute to the formation of dissolved cesium concentration in stream water. The flow rates of spring water and stream water in the test basin were observed, and the concentrations of dissolved cesium-137 and various dissolved ions contained in spring water, stream water, and soil water were measured. A net and a suspended sediment sampler were installed downstream of the test basin to capture coarse organic matter, and the concentration of cesium-137 in the coarse organic matter and suspended sediment was measured. In addition, rainfall and temperature were observed, and research was conducted to elucidate the formation mechanism of radiocesium concentration in stream water based on those observation data. The survey period was approximately one year and six months from June 2018 to December 2019. The observation results showed that dissolved cesium-137 concentration in stream water increased with increasing temperature from June to July and decreased with increasing flow in August. In winter, a slight increase was observed. The concentration of soil water is higher than that of stream water by about 1-2 orders of magnitude, and the concentration of dissolved cesium-137 in the stream water and soil water showed a positive correlation. Furthermore, the concentration of dissolved ¹³⁷Cs in the stream water tended to increase from the spring point toward the downstream. From the above results, the concentration of dissolved cesium-137 in stream water shows seasonal changes with changes in temperature and flow rate. Moreover, the dilution effect due to the increase in flow rate, the mixing with soil water in the process of stream water flow down, and the effect of leaching from the coarse organic matter deposited the forest floor and river channels was suggested.

Keywords: dissolved Cs-137, Fukushima Dai-ichi nuclear power plant accident, stream water