Spatial distribution of dissolved Cs-137 at small Headwater Forested Catchment in Fukushima after Fukushima Dai-ichi Nuclear Power Plant Accident

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Radiocesium migration from headwater forested catchment is important perception as output from the forest which is also input to the subsequent various land use and downstream rivers after Fukushima Dai-ichi Nuclear Power Plant (FDNPP) accident. In this study, dissolved Cs-137 concentration of stream water, soil water and groundwater were measured. Observations were conducted at headwater catchment in Yamakiya district, located 35 km northwest of FDNPP from April 2014 to November 2015. Stream water discharge was monitored and stream water samples were taken at main channel and sub channel. Stream water discharge was monitored by combination of parshallflume and v-notch weir. Stream water was sampled manually at steady state condition in 3-4 month interval and also intense few hours interval sampling were conducted during rainfall events using automated water sampler. Around the sub channel, it is found that there is a regularly saturated area at the bottom of the slope, temporary saturated area which saturate during the rainy season in summer and regularly dry area. 6 interval cameras were installed to monitor the changing situation of saturated area. Suction lysimeters were installed at three areas (regularly saturated area, temporary saturated area and dry area) for sampling soil water in depth of 0.1 m and 0.3 m. Boreholes were installed at three points along the sub channel. Three boreholes with depth of 3 m, 5 m and 10 m were installed at temporary saturated area, 20 m upstream of sub channel weir. Another three boreholes with depth of 3 m, 5 m and 10 m were installed at dry area, 40 m upstream of sub channel weir. And a borehole with depth of 20 m was installed at ridge of sub catchment, 52 m upstream of sub channel weir. Groundwater was sampled by electrically powered pump and groundwater level was monitored. Also suction-free lysimeter was installed at temporary saturated area for sampling the near surface subsurface water. Soil water samples were collected as much as collected in flask. Stream water and groundwater samples were collected for 40 L each. All the water samples were filtered through 0.45 μm pore-size membrane. Water samples with less than few L were concentrated by evaporative concentration. Water samples with more than 40 L were concentrated using the ammonium molybdophosphate (AMP)/Cs compound method. The Cs-137 concentration was determined using Gamma-ray spectrometry with a germanium semiconductor detector.
Spatial distribution of dissolved Cs-137 concentration in the slope was obtained and the source of Cs-137 concentration in stream water was examined. The Cs-137 concentration in groundwater showed low value of around 0.001 Bq/L. The Cs-137 concentration of soil water showed 0.01-0.1 Bq/L. And Cs-137 concentrations of stream water were in order of 0.01-0.1 Bq/L at steady state condition. Also Cs-137 concentrations in stream water showed temporary increase during rainfall event. The source of dissolved Cs-137 was suggested to be shallow soil water under saturated condition or leaching from the litter might be affecting.

Keywords: Dissolved Cs-137, FDNPP, stream water, soil water, groundwater

