Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MAG38-10 会場:301B 時間:5 月 26 日 11:30-11:45

福島県山木屋町の山地源流域における溶存態・浮遊砂・粗大有機物によるセシウム 137 流出
Radioactive Cs-137 discharge by Dissolved water, Suspended Sediment and Coarse Organic Matter from Headwater Catchment

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The Fukushima Dai-ichi Nuclear Power Plant (FDNPP) accident, following the earthquake and tsunami disaster on March 11, 2011, resulted in a substantial release of radionuclides to the environment. Most of the area in which the radionuclides were deposited was forested area. Therefore it is very important to quantify the discharge of radionuclide from the forested catchment in headwater region which will be the input of the radionuclide to downstream various land use.

The concentration of dissolved ^{137}Cs in groundwater and stream water in the headwater catchments in Yamakiya district, located ˜35 km north west of Fukushima Dai-ichi Nuclear Power Plant (FDNPP), was monitored from June 2011 to December 2014. Also ^{137}Cs concentration in suspended sediments and coarse organic matter such as leafs and blanches were monitored. Groundwater and stream water were sampled at intervals of approximately 2 months at each site. Intensive sampling was also conducted during rainstorm events. Compared with previous data from the Chernobyl NPP accident, the concentration of dissolved ^{137}Cs in stream water was low. In the Iboishi-yama catchment, a trend was observed for the concentration of dissolved ^{137}Cs in stream water to decline, which could be divided into two phases by October 2011 (after 200 days after the accident).

The highest ^{137}Cs concentration recorded at Iboishi-yama was 1.2 Bq/L at the peak on August 6, 2011, which then declined to 0.021-0.049 Bq/L during 2013 (in stream water under normal water-flow conditions). During the rainfall events, the concentration of dissolved ^{137}Cs in stream water increased temporarily. The concentration of dissolved ^{137}Cs in groundwater at a depth of 30 m at Iboishi-yama displayed a decreasing trend from 2011 to 2013, with a range from 0.039 Bq/L to 0.0025 Bq/L. The effective half-lives of stream water in the initial fast flush and secondary phases were 0.1-0.2 y and 1.0-2.2 y, respectively, in the three catchments. The trend for the concentration of dissolved ^{137}Cs to decline in groundwater and stream water was similar throughout 2012-2013, and the concentrations recorded in deeper groundwater were closer to those in stream water. The declining trend of dissolved ^{137}Cs concentrations in stream water was similar to that of the loss of canopy ^{137}Cs by throughfall, as shown in other reports of forest sites in the Yamakiya district.

The ^{137}Cs concentration in suspended sediments showed 10000-45000 Bq/kg and ^{137}Cs concentration in organic matter showed 1000-12000 Bq/kg. The ^{137}Cs concentration in organic matter showed declining trend through the observation period and the trend was similar to that of dissolved ^{137}Cs concentration in stream water. In contrast ^{137}Cs concentration in suspended sediment did not showed a clear declining trend in every catchment (before the decontamination works). After the decontamination works in Iboishi-yama catchment, the ^{137}Cs concentration in suspended sediment declined largely to 200-300 Bq/kg. The ^{137}Cs concentration in organic matter and dissolved ^{137}Cs concentration in stream water did not declined largely.

In conjunction with discharge data and turbidity data, ^{137}Cs discharge flux were calculated for three components (dissolved water, organic matter, suspended sediments). As a result, it is shown that more than 98% of the ^{137}Cs discharge was due to the discharge by suspended sediments. It is also suggested that dissolved ^{137}Cs concentration have relationship with ^{137}Cs concentration of organic matter and so it is still important to clarify the process of ^{137}Cs migration through dissolved water and organic matter.

キーワード: セシウム 137, 溶存態, 浮遊砂, 粗大有機物, 源流域, 流出
Keywords: Cs-137, Dissolved water, Suspended sediment, Coarse organic matter, Headwater catchment, Discharge