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Cesium decrease with groundwater residence time in natural spring drinking water

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It is known that the active Cs sorption onto colloidal-size clay minerals in groundwater is observed and the active Cs can be transported with the colloidal fraction of groundwater by water flows. However, the longtime behavior of radioactive and non-active Cs, contained in the flowing groundwater in the aquifers of groundwater source areas, is unknown in terms of the natural water cycle. Herein, we investigate the non-active Cs concentration in natural spring drinking water with the residence time in a groundwater source area of a mountainside composed of volcanic rock, compared with those of other trace elements. This investigation demonstrates that the observed Cs concentration in natural spring drinking water exponentially decreases slowly with the groundwater residence time (˜45 yr), while several trace elements, namely, P, V, Ga, and Ge, increase in concentration with the groundwater residence time through chemical weathering. The findings suggest that active Cs, contained in flowing groundwater in mountain water source areas, may decrease exponentially at the rate of one-tenth in twenty-two years, by sorption onto the aquifer through rock-water interaction excluding radioactive decay. For the sustainable management of water sources and ecosystems, the long-term (˜50 yrs.) monitoring of the active Cs in groundwater is needed in mountain water source areas where radioactive cesium has been dispersed at times of nuclear power plant accidents.

Keywords: Cesium, Groundwater, Residence time, Sulfur hexafluoride, Yatugatake