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Temporal change of residence time for three years in spring and groundwater at a mountainous headwater catchment

Kosuke Nagano (1), Maki Tsujimura (2), Koichi Sakakibara (1), Yuichi Onda (2), and Sho Iwagami (1)

(1) Graduate School of Life and Environment Sciences, University of Tsukuba, Japan (s1721235@s.tsukuba.ac.jp), (2) Faculty of Life and Environmental Sciences, University of Tsukuba, Japan

We monitored a temporal change of the residence time in spring and groundwater in a headwater catchment in Fukushima prefecture, Japan from April 2015 to August 2017. We conducted periodical sampling of spring water and groundwater at intervals ranging from a month to three months (totally 19 times), and SF_6 concentration, stable isotopic compositions (δ18O, δ2H), and inorganic solutes concentration were determined on all water samples. Also, the monitoring of stream flow, rainfall and groundwater level were performed.

The SF_6 apparent age of spring water ranged from less than one year to 12 years, and that of groundwater ranged from less than one year to 27 years. Especially the age of the groundwater at the ridge was longer than that at the hillslope and the valley. The apparent age of spring water during the high runoff period was younger than that during the low runoff period, whereas the groundwater age did not show such trend. However, the age of the spring water showed so young (less than one year) just after the rainstorms, also the groundwater age became young in this period. Therefore, young water seems to contribute dominantly to the spring water and groundwater during this period. Additionally, the age of the groundwater and the spring water was old when the groundwater table was high at the ridge. This suggests that the groundwater with older age at the ridge contributes dominantly to the spring water, when the groundwater level was high, whereas the spring runoff was low due to a time lag between the ridge groundwater level and the spring discharge.