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Subsurface flow processes of the soil and bedrock in a small headwater catchment

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The hydrometric and tracer approaches were applied to investigate subsurface water flow processes of the soil and bedrock in a small headwater catchment underlain by sandstone, Karasawan University Forest, Tokyo University of Agriculture and Technology, Tochigi prefecture, eastern Japan.

During the observation period (June 19, 2010 - December 29, 2010), 862 mm precipitation were observed and the runoff ratio of the monitored spring discharge was 32%, that suggesting a large amount of groundwater infiltrate into the bedrock.

Groundwater level changed in the boreholes drilled into the bedrock with a similar trend of hydrograph at spring. The lag time from rainfall peak to the runoff peak shows a good correlation with that of groundwater level. This suggests that the groundwater flow hydraulically connects with the spring discharge.

End-member mixing analysis was applied to evaluate the runoff components using SiO_2 and HCO_3^- concentrations as tracers. Contribution ratio of the bedrock groundwater to the runoff was estimated to be more than 60% during a secondary runoff peak.

The CFCs concentrations show an average residence time of the spring water to be approximately 20 years.

Keywords: headwater catchment, sandstone, rainfall-runoff process, bedrock groundwater, end-member mixing analysis, CFCs