

Behavior of tracer elements of subsurface water in a hilly headwater catchment, Toyota, Japan

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The temporal and spatial change of tracer elements such as oxygen 18, deuterium, chloride and silica concentrations of stream and subsurface waters was investigated in a headwater catchment of Toyota Hill, Aichi prefecture, central Japan. The catchment has an area of 0.857 ha with an altitude of 60 to 100 m, and is underlain by granite. The ratio of event water component to the total runoff water at the peak discharge ranged from 8 to 98 %, and the event water ratio correlated with the peak discharge rate and rainfall intensity. The shallow subsurface flow at the lower-slope and overland flow on the riparian zone would contribute much to the stream water chemistry during heavy rainstorms.

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The rain, stream, soil and ground waters were sampled once in a week, and the stream water was sampled hourly during rainstorms. The pressure head of soil and ground waters were monitored using tensiometers and piezometers nests, and stream flow was monitored using V-notch weir. The stable isotopic ratios of deuterium and oxygen 18 and inorganic ion concentrations were determined on all water samples.

The oxygen-18 isotopic ratio in stream water decreased during the rainstorms with peak rainfall intensity more than 2 mm/5min. The ratio of event water component to the total runoff water at the peak discharge ranged from 16 to 92 %, and the event water ratio correlated with the peak discharge rate and rainfall intensity. The piezometric and tensiometric data showed that the shallow subsurface water with low oxygen-18 isotopic ratio, which corresponds to that of precipitation in the valley bottom, discharged directly to the stream during the heavy rainstorms. The shallow subsurface flow at the lower-slope and overland flow on the riparian zone would contribute much to the stream water chemistry during heavy rainstorms.