

Consideration for the formation process of vertical profile of stable isotopic compositions in soil water

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In recent years, it has become important to make clear the soil water movement for preventing the groundwater pollution and establishing sustainable water use. Using the stable isotopic compositions of oxygen and hydrogen has been pointed out as one of the effective methods to estimate the soil water movement.

The soil water in the loamy soil were sampled at Terrestrial Environment Research Center at University of Tsukuba, Japan, eleven times from April to November in 2001, and groundwater, monthly precipitation and event precipitation are also collected. The stable isotopic compositions of oxygen and hydrogen were analyzed for all samples. In the vertical profiles of isotopic compositions in soil water, the variations of isotopic composition near the soil surface are very large, because soil water is affected by the evaporation and precipitation. The variation, however, decreases gradually as the soil depth. Isotopic compositions become almost constant near the water table. Furthermore, some cyclic variations are observed in the vertical profiles of isotopic compositions of soil water. The time series variations of isotopic composition in soil water and precipitation suggest that the isotopically heavy peak of soil water was formed in summer period, and it moved downward during fall season when intensive rainfall happened. It is also indicated that the piston flow is dominant in this study site. The data of isopleth indicate that groundwater recharge occur under the condition that rainfall amount exceeds 50 mm per event, which is agree with the result of delta-diagram of different size event precipitation and groundwater. Downward movement of cyclic variation, however, not always happen in the cases of same rainfall amount. A comparison of profiles from isotopic compositions, volumetric water content and hydraulic conductivity suggests that downward movement of vertical profiles of isotopes are influenced not only rainfall amount but also moisture condition in the unsaturated zone.

The isotopic composition in soil water can be used for estimation of the soil water movement in these places such as depositing of loamy soil mainly in Japan.