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Spatial distribution characteristics of stable isotopes in groundwater, spring water and precipitation samples at Kyoto

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Kyoto is an old city in Japan which has more than 1000 year's history. Kyoto basin spreads from Kyoto to Osaka Prefecture. The area of the basin is about 18 km from north to south and about 10 km from east to west. An alluvial fan is formed in the basin by the Kamo and Katsura river. The sand and gravel are deposit thickly at the alluvial fan, and the thickness is about 100 m at the fan head and from 300 to 400 m at the fan end. There is some aquifer in the basin and a large quantity of groundwater is stored in this basin, so many people who live in the Kyoto city have used the groundwater a long period.

In the Kyoto basin, the stable isotope of oxygen changes from -8.9 to -5.3 per mill and hydrogen changes from -58 to 35 per mill. The stable isotopes are relatively low with the high elevation and relatively high with the low elevation in the mountainous area. The stable isotopes in groundwater around Kamo river are constant ($d^{18}\text{O}$: -7.8 per mill, $d\text{D}$: -50 per mill) and don't depend on the groundwater level. Thus the isotopes of groundwater around Kamo river are almost corresponding to isotopes of Kamo river, it is assumed that the groundwater is recharged from Kamo river in this area. The SiO_2 concentration and water quality in groundwater and river water suggest this result.

The precipitation samples have been sampled every two months at three points of P-1 (32.5 m a.s.l.), P-2 (100 m a.s.l.) and P-3 (310 m a.s.l.) since September 2009. The water quality, stable isotopes of oxygen and hydrogen were analyzed for all precipitation samples. The amount-weighted value of $d^{18}\text{O}$ is -7.9 per mill at P-1, -8.1 per mill at P-2 and -8.4 per mill at P-3. The altitude effect of precipitation in this area is -0.17 per mill /100 m for $d^{18}\text{O}$ ($r^2=0.981$) and -0.7 per mill / 100 m for $d\text{D}$ ($r^2=0.819$). The altitude effect of the groundwater and spring water near the precipitation sampling points also exists. In the future, we will estimate the groundwater flow and recharge area in Kyoto basin by using the stable isotopes in groundwater and precipitation samples.

Keywords: Kyoto basin, groundwater, spring water, precipitation, water quality, stable isotope