Hydraulic connectivity between groundwater and surface water in Suwa region, Japan

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Understanding interaction between groundwater and surface water is important to consider a sustainable water resources management. Environmental tracers such as inorganic ions and oxygen/hydrogen stable isotopes have been recognized as useful tracers to obtain an information of connectivity between groundwater and surface water. The people in Suwa region strongly rely on the groundwater for the principal water resource; however, there are few consensuses of water resource recharge processes regarding relationship among precipitation, surface water, and groundwater. Therefore, the objective of this study is to clarify a water resources recharge process through the indication of the hydraulic connectivity between groundwater and surface water in Suwa region, Japan. For this, groundwater table levels in four locations were monitored throughout the year. In addition, lake water, river water, groundwater, and precipitation were periodically sampled to determine the environmental tracer information.

Monitored groundwater table levels presented different trends in space and time. Considering hydraulic potential distribution from mountain side to lake side, the groundwater in mountain side had higher potential than that in lake side throughout the year. This suggests the groundwater mainly flows from mountain side to the lake. Groundwater table level rose a maximum of about 1.3 m in the vicinity of the lake from spring to summer seasons; however, the temporal trend was much different between surface (lake) water and this groundwater. This indicates the lake water and groundwater near the lake might not be hydraulically connected. For more detailed discussion about connectivity between the lake and groundwater, it is necessary to get hydraulic potential data in several wells near the lake.

Stable isotopic compositions of sampled water were plotted near the local meteoric water line on the delta diagram, indicating sampled water (groundwater and surface water) mostly originated from precipitation. However, determined stable isotopic compositions of oxygen and hydrogen in precipitation ranged from −16.5‰ to −7.9‰ and from −121.0‰ to −42.0‰, whereas those in other water ranged from −12.4‰ to −10.0‰ and from −85.6‰ to −69.8‰. This result suggests that although precipitation should contribute groundwater recharge, this process is not fast and direct phenomenon. No clear temporal variation of chemistry in groundwater samples was observed even in the season with large amount of rainfall, supporting that interpretation.

In terms of interaction between groundwater and river water, observed stable isotopic compositions of all groundwater samples had the value within the range of those in river water. This may indicate the groundwater consists of river water affected by the precipitation. However, this interpretation is still weak; thus, the river water role on the groundwater recharge should be examined in the future work in Suwa region.

Keywords: Suwa region, interaction between groundwater and surface water, hydraulic potential, inorganic ions, oxygen/hydrogen stable isotopes

