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Groundwater recharge mechanism revealed by stable isotopes and chemical solutions analysis in an hyperarid area, western China

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The objective of this study is to clarify groundwater recharge mechanismin a hyperarid area, the lower reaches of the Heihe river basin, Gansu Province and Inner Mongolia, western China. The river is typically an inland river in an arid area, which originates from glaciers in the headwaters and disappears in the lower reaches. The basin could be divided into three reaches by the topography and the vegetation. The lower reaches are characterized as a hyperarid area, which have little vegetatated desert except for riverside area. Groundwater level measurements and collecting water samples involving groundwater, river water and precipitation were made in the lower reaches. Melt water of a glacier in the upper reaches were additionally sampled. Stable isotopic compositions of oxygen and deuterium, and chemical compositions were analyzed for all samples. The results are summarized as follows.
We conclude that the mechanism in the area is completely divided into two modes. The modes are depended on land covers, which are riverside (covered with vegetation along the river) and desert areas. Shallow groundwater in the riverside area derived from the river water. Hence, recharge scarcely occurs during no-runoff season. During runoff season river flow causes groundwater recharge. The river water becomes affected by evaporation after infiltrated. Consequently, observed isotopic and chemical compositions of the groundwater are enriched. On the other hand, shallow groundwater in the desert area derived from only high intensity precipitation in the lower reaches. Observed stable isotopes of the groundwater are slightly enriched compared with that of the precipitation. The groundwater recharge, therefore, occurs without being affected by evaporation. The precipitation causes groundwater recharge even in the hyperarid area with annual precipitation is less than 50 mm.

Keywords: groundwater recharge; hyperarid area; stable isotope; chemical composition