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Groundwater circulation and hydrogeochemical evolution in a typical alluvial-lacustrine plain of Qaidam Basin, Northwestern China

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Abstract：In this study, hydrochemistry and isotopic tools were combined to get an insight into the recharge condition, flow pattern, processes controlling mineralization of groundwater in Nuomuhong district, which is a typical arid alluvial-lacustrine plain located in the southeast of Qaidam Basin, northwestern China.

Data inferred from deuterium and oxygen-18 isotopes in groundwater samples indicated recharge with meteoric water and glacier melt-water in the Kunlun Mountains. Hydrogen and Oxygen stable isotopes were observed to deplete gradually along the flow path, and the sampled points can be clustered into three groups (Group A, B, C) based on the isotopic data. The δ^2H and $\delta^{18}O$ values of Group A have the same range with the modern recharge water, which suggested the groundwater of Group A is recharged by modern water with temperature of 4.5℃；Group B and C have lower δ^2H and $\delta^{18}O$ values than modern recharge water, indicating lower recharge temperature with the noble gas temperatures (NGTs) of 2.61℃ and 0.25℃, respectively.

The radiogenic (^3H and ^{14}C) isotope data provides insight to the groundwater flow pattern. Groundwater flows from mountain front to the central basin with ^3H concentration and ^{14}C activity decreased gradually. While ^3H concentration is unexpectedly decreased at the front of alluvial fan and abnormal high values observed at the front of left wing. This phenomenon indicates the groundwater is blocked by Arcuate Ridge Structure located at the front of alluvial fan. As a result, the flow direction of partial shallow groundwater turns to northwest, and eventually feeds the Tiangeli River. Mean residence time of groundwater is determined with ^3H concentration and ^{14}C activity and suggests ages ranging from present to Holocene (~28ka).

Analysis of the dissolved constituents revealed that groundwater evolution from fresh water(TDS=300-1000 mg/l) to saline water(TDS≥5000 mg/l) along the flow paths. The water type changes from HCO_3-Cl-Na-Mg in the alluvial fan to HCO_3-Cl-Na in the overflow zone, eventually to Cl-Na in the basin center. Groundwater chemistry evolution is mainly controlled by rock dominance and the evaporation-crystallization process. Rock dominance, including minerals dissolution, cation exchange and silicates weathering, is the main process controlling groundwater chemistry in the alluvial fan and overflow zone. While hydrochemistry of groundwater in the central basin is mainly controlled by evaporation-crystallization processes including strongly evaporation, carbonate precipitation and cation exchange releasing Ca^{2+} and adsorbing Na^+.

***Keywords*：** Hydrochemistry；Groundwater circulation；Isotopes；Water-rock interaction；Qaidam Basin