Origin and formation mechanism of salty water in an inland catchment: an example from Zuli River catchment in the upper reaches of Yellow River

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The Zuli River is one of branches of the upper Yellow River, where the TDS in both groundwater and surface water are very high and lose the basic function of water resources. In the studied area, the mean annual precipitation is below 370mm and the potential evaporation is nearly five times as the precipitation. As an inland catchment in northwestern China, the origin and formation mechanism of salty water has remained unclear. This research conducts multiple investigating and sampling for Zuli River by the means of hydrochemistry .The study mainly aimed to uncover the origin and formation mechanism of salty water.

Values of the total dissolved solids (TDS) in samples are highly variable ranging from 2062 to 8492 mg/l. The hydro-chemical types of groundwater samples from the source area are dominated by the Mg–Ca–Na–HCO_3. River samples are highly mineralized and dominated by a Na–Mg–Cl–SO_4 type. With the increasing of TDS, the relationship between Na^+ and Cl^- showing a simultaneous increase and the molar Na^+/Cl^- ratio of most samples is larger than 1.The saturation indices (SI) values for calcite and dolomite are above 0.5 and so indicate a saturation state with respect to calcite and dolomite mineral phase in the catchment.

The high salinity in the Zuli River catchment is mainly formed by: the cation exchange and absorption, upstream groundwater leaching the salinity of stratum and discharging toward the river in springs, and eroding the soil salts in both sides of hills outside river banks. During the runoff process, the arid climate makes the water body further evaporation and concentration, which is the external hydrochemistry evolutionary process of the TDS further increase in the catchment.