Hydrogeochemical indication of multistage groundwater flow system in arid and semi-arid regions: A case study of Aksu River basin, Xinjiang, China

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Abstract

In arid and semi-arid areas, groundwater flow is a potent geological agent. The typical profile of Aksu river basin was chosen as the research object. First, the survey region's geological background and hydrological conditions were systematically analysed. Combined with geophysical and remote sensing characteristics, the thickness change of the Quaternary loose layer, boundary of the subaqueous system, and basement of the water circulation depth were revealed. Hydrogeochemistry and environmental isotopes were applied to explain the recharge-runoff-discharge process, water-rock interaction, movement law, and residence time of surface-groundwater. Owing to the dissolution of carbonate and gypsum minerals and evaporates, cation exchange between Ca^{2+} (Mg^{2+}) and Na^{+} (K^{+}), and the evaporation-concentration effect, specific ions (SO_4^{2-}, Cl^{-}, Na^{+}) and [total dissolved solids](javascript:;)(TDS) from the surface to groundwater gradually increased with the flow direction and gradually decreased with depth. This difference was more evident in the downstream discharge area, which indicated that they belonged to different groundwater flow systems(GFSs).Because of the elevation effect of the recharge source, the $\delta^{18}O$ values in different sections showed different degrees of depletion in the horizontal and vertical directions. In [association with](javascript:;) the structural 'one convex and two concaves' frameworks and the particle size variation of loose sediments, it reflected the distribution pattern of multiple local GFSs. The vertical zonation between the ^{3}H and ^{14}C isotope concentrations and the recorded groundwater [residence](javascript:;) time (modern-24000years) further illustrated the existence of intermediate and regional GFSs. Three surface-conversion boundary key zone (GFS_{cbz}) were identified, and the GFS conceptual model was established. Finally, the corresponding relationship between the GFSs and the environmental effects, such as the distribution and aggregation of phreatic water with high F and As and soil salinization, were analysed, which had important theoretical significance for protecting the ecological balance of Aksu River basin.

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