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A hydrochemistry and multi-isotopic study of groundwater origin and hydrochemical evolution in the middle reaches of the Kuye River basin

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Abstract: The Kuye River basin lays in an economically and ecologically important area, therefore, the groundwater quality issues are of growing concern in this semi-arid region. In the present study, the combination of techniques (i.e. piper diagram, ionic ratios, Gibbs diagrams, multiple isotopic analyses etc.) provided an efficient way for analyzing the groundwater origin and hydrochemical processes that affected water chemistry. The groundwater type was Ca-HCO_3 in low TDS values and Na-Cl/SO_4 in high TDS values in both shallow unconfined and deep Cretaceous-Jurassic semi-confined aquifer. And, furthermore, Na^+, Cl^-, SO_4^{2-} and F^- were the dominated parameters deteriorating the groundwater quality. In general, groundwater was of meteoric origin and the more depleted $\delta^{18}O$ and δD features of CJY groundwater samples indicated that the groundwater was formed during the wetter and colder climate. The rock weathering in conjunction with the cation exchange absolutely predominated in geochemical evolution and deuterium excess method quantified that mineral dissolution contributed most of the salinity (67-92%) of the groundwater. The SO_4^{2-} of the groundwater was primary from the dissolution of sulfate minerals, next was the atmospheric precipitation. In addition, bacterial sulfate reduction was an important reaction affecting the SO_4^{2-} concentration in the groundwater from CJY aquifer. The hydrochemical type of high fluoride groundwater in the study area was Na-HCO_3 or Na-Cl/SO_4 and it was mainly from the