Chemical and strontium isotopic characteristics of the rivers around the Badain Jaran Desert, north China

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The chemical and strontium isotopic compositions of four major rivers were measured to better understand the hydrochemical processes and solute sources of surface waters around the Badain Jaran Desert, North China, in the arid and semi-arid region. All these rivers originate from the north foot of Qilian Mountains, northeastern Tibetan Plateau, and Heihe, Beida and Shiyang rivers drain around the Badain Jaran Desert located in Inner Mongolia, China. Heihe River is the second largest inland river in China.

These rivers have high total cationic charge (TZ+) ranging from 3,271 to 11,439 μEq, with an average of 7,379 μEq, which is significantly higher than the global rivers' average. The major ion compositions of the river waters are characterized by the dominance of Ca^{2+}, Mg^{2+} and HCO_3^-, and significantly rich in SO_4^{2-} and Cl^-. River waters are slightly alkaline and are characterized by high total dissolved solids (TDS). TDS values varied from 249 to 895 mg/l, with an average of 511 mg/l. The increase in TDS and major ions (Na^+, Cl^- and SO_4^{2-}) concentrations from upper to lower reaches is ascribed to both extensive effect of evaporation and the evaporite dissolution in the arid and semi-arid areas. $^{87}Sr/^{86}Sr$ ratios of these rivers ranged between 0.7102 and 0.7163, with an average of 0.7132. The chemical and Sr isotopic analyses indicate that three major weathering sources (evaporites, carbonates and silicates) contribute to the total dissolved loads. The quantitative solute sources are first calculated using a forward model in this area. The results show that the dissolved load is dominated by carbonates weathering and evaporites dissolution, which accounts for about 84% of the total dissolved cations in the area.