Goldschmidt 2025 Abstract
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Title:Origin and evolution of deep lithium-rich brines in the southwest Jianghan Basin, central China: Evidence from hydrochemistry and stable isotopes

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Lithium-rich brines from the upper Cretaceous and lower Eocene in the Jiangling depression, southwest Jianghan Basin were collected. In order to study the origin, evolution of the brines and the enrichment mechanism of lithium, the hydrochemical compositions and stable isotopes of the brines were tested and analyzed. The highest concentrations of potassium and lithium in the brine were 3.21 g/L and 97.85 mg/L, respectively. The brines of upper Cretaceous are mainly weakly acidic, while the lower Eocene brines are acid to alkalescent, and they are all Cl-Na type water. Compared with the ion trajectories of seawater evaporation, the brines showed enrichment of Cl, Ca, and Sr and depletion of Mg, which may be due to the dissolution of halite and water-rock interaction. The δD and $\delta^{18}O$ compositions of the brines in both aquifers are similar, with δD values ranging from -51.4 to -33.0 ‰ and $\delta^{18}O$ values ranging from -3.8 to 3.7 ‰. The data of δD and of $\delta^{18}O$ indicate that the two aquifer brines originated from meteoric waters and experienced intense evaporation. The $^{87}Sr/^{86}Sr$ values (0.710144 to 0.712448) in the Upper Cretaceous brines are similar to the Paleocene sandstones, and the $^{87}Sr/^{86}Sr$ values (0.709982 to 0.710806) in the Lower Eocene brines are similar to the Paleocene anhydrite and glauberite. And the average content of lithium element in the upper Cretaceous brine is 54.38 mg/L, and the $\delta^{7}Li$ values ranges from 10.2 to 14.1 ‰; the average content of lithium in lower Eocene brine is 23.81 mg/L, and the $\delta^{7}Li$ values ranges from 17.7 to 21.9 ‰. The characteristics of $^{87}Sr/^{86}Sr$ and $\delta^{7}Li$ indicate that the water-rock interaction between brine and silicate rock and the dissolution of halite lead to the enrichment of lithium in the brine of the two aquifers.