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Hydrochemical characteristics and stable isotopic compositions of drip waters responding to the change of local hydrological conditions and atmospheric circulation——Based on 12 years' monitoring work from China

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Cave monitoring is crucial for the interpretation of climatic and environmental significances of various geological proxies in speleothem. Therefore, the hydrochemical and stable isotopic compositions (δ18O, δD, Mg/Ca, Sr/Ca, and Ba/Ca) of karst cave waters during 2005–2016 A.D. were constantly monitored in Furong Cave, Chongqing City, Southwest China. A comparison with local hydrothermal conditions led to a few conclusions as follows: (1) The Mg/Ca ratio is significantly responsive to the changes in drought/wet conditions outside the cave, which increased in drought years and decreased in wet years, respectively. Seasonal variation of Sr/Ca is more significant than those of Mg/Ca and Ba/Ca ratios. (2) Prior calcite precipitation (PCP), incongruent calcite dissolution (ICD), water-rock interaction (WRI), and pCO_2 of soil and cave air, may account for the changes in trace element ratios in the epikarst, which resulted in a complex variation of element ratios in the cave drip water. In general, WRI in drought years is stronger than that in wet years, and that in low discharge sites is stronger than in high discharge sites. Seasonal variation of Ca2+ concentration, induced by PCP, exerts significant impact on the evolution of Sr/Ca ratio in drip water. (3) δ18O and δD of drip water are influenced by the "mixing effect", leading to the result that their seasonal variations are less significant than that of precipitation. (4) At least in the study period, the ratios of trace elements in the drip water in Furong Cave mainly reflected the variations of local hydrological conditions (drought or wet) dominated by precipitation. In contrast, changes in δ18O and δD did not exhibit the "amount effect" in drip water on monthly timescale. High-resolution δ18O record (e.g., seasonal and annual) of speleothem in Furong Cave may not be recommendable. However, the δ18O is potentially a reliable proxy in speleothems to record the change of rainfall on interannual and longer timescales. Furthermore, on interannual timescale, large scale variation of atmospheric circulation, such as El Niño-Southern Oscillation (ENSO), can change the δ18O of precipitation and that of drip waters by changing the moisture source at different atmospheric circulation conditions.