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Variations in regional hydrological environment and human activities inferred from $\delta^{18}O$ and $\delta^{2}H$ of stalagmite fluid inclusions in southwest China

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The interpretation of $\delta^{18}Oc$ and $\delta^{13}Cc$ values of stalagmites within China is still complex, although numerous cave archives have been reported in this region. Present challenges include distinguishing between natural and anthropogenic influences on regional hydrological and environmental changes, in particular due to the increasing human activities during the mid-to late Holocene. Here, we report for the first time the $\delta^{18}O_{fi}$ and $\delta^{2}H_{fi}$ records of fluids entombed as inclusions during the Holocene (6290 to 690 yr BP) from a stalagmite from southwest China. We excluded measurement-induced artefacts using Rayleigh fractionation models and improved measurement methods, producing reliable results. We observed very high $\delta^{18}O_{fi}$ and $\delta^{2}H_{fi}$ values during a weak Asian summer monsoon (ASM). Our record reveals six drought events during the mid- and late-Holocene (~950, 1360, 2260, 3450, and 5600 yr BP), which coincide with the weakening of ASM intensity and variations in low latitude forcing, such as tropical sea surface temperature, El Niño/Southern Oscillation, and intertropical convergence zone. In 950-1100 A.D., the dramatic enrichment of $\delta^{18}O_{fi}$ (magnitude ~7‰) corresponds with the increase in regional population density due to large-scale population migration at this time (historically known as the Jingkang event). The overall coefficient of variation (C.V = standard deviation/mean) of the $\delta^{18}O_{fi}$ sequence is 125% compared to only 5% for $\delta^{18}Oc$. Hence, $\delta^{18}O_{fi}$ seems to exhibit a greater sensitivity to regional environment wet/dry variations than traditional carbonate isotope proxies.