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Controls on oxygen isotope variability in precipitation and drip water at eight caves in the monsoon regions of China

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Cave monitoring is important to fully understand the climatic significance of stalagmite δ^{18}O records. Most previous studies focus on one cave, or several caves in one area. A large regional-scale investigation on the isotopic composition of precipitation and drip water is scarce. To investigate the regional-scale climate forcing on the oxygen isotopic composition of precipitation in the monsoon regions of China (MRC) and how the isotopic signals are transmitted to various drip sites, a three-year-long (2011-2014) on-site rainfall and drip water monitoring program has been carried out with approximately monthly sampling at 37 drip sites in eight caves in the MRC.

Neither rainfall amount nor air temperature are the predominant controls on the oxygen isotopic composition of monthly precipitation. The rain in the wet season (May to October), with relatively low δ^{18}O values, is sourced from tropical air masses, whereas the rainfall in the dry season (November to April), with relatively high δ^{18}O values, is mostly sourced from continental air masses. Additionally, the weighted summer rainwater δ^{18}O values decrease from coastal southwest China to inland northeast China, which suggests that the moisture of monsoon rainfall in China originates mainly from Indian Ocean, and transports to the north along the southwest-northeast path.

28 of the 37 drip sites are constant drips with little discernable variation in drip water δ^{18}O through the whole study period. For most of the constant drips, the mean value of each drip water δ^{18}O is nearly identical to or slightly higher than the three-year weighted mean value of the corresponding local rainwater δ^{18}O, indicating these drips may be mainly recharged by none-evaporated or slightly evaporated, well-mixed older water stored in the vadose zone. 7 of all the 37 drip sites are seasonal drips, for which, although the amplitude of drip water δ^{18}O is narrower than that of rainfall, the monthly response of drip water δ^{18}O to local precipitation is not completely dampened. Specially, there are 3 sites in Shihua cave which can be classified not only as a seasonal drip but also as a constant drip. 2 of all the 37 drip sites are medium-variability drips, with constant and relatively negative drip water δ^{18}O values in the wet season but with variable and relatively positive drip water δ^{18}O values in the dry season. However, their essential recharge mode is different. For these drips, the drip water δ^{18}O is not only unable to inherit the seasonal signals but also unable to inherit the long-term signals of the precipitation. Consequently, the factors controlling the oxygen isotopic composition of drip water and then the stalagmite is site-specific. In principle, though, for most of the stalagmites, the δ^{18}O profile may record the annual or longer time-scale climatic signals of rainfall δ^{18}O.