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Stable Isotope Study of Precipitation and Cave Drip Water in Florida (USA): implications for speleothem-based paleoclimate studies

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Abstract:

Stable isotopes of hydrogen and oxygen were used to examine how the isotopic signal of meteoric water is modified as it travels through soil and epikarst into two caves in Florida. Surface and cave water samples were collected every week from February 2006 until March 2007. The isotopic composition of precipitation at the investigated sites is highly variable and shows little seasonal control. The $\delta^{18}\text{O}$ vs. $\delta^2\text{H}$ plot shows a mixing line having a slope of 5.63, suggesting evaporation effects dominate the isotopic composition of most rainfall events of less than 8 cm/day, as indicated by their low d-excess values. The $\delta^{18}\text{O}$ values of the drip water show little variability (<0.6‰), which is loosely tied to local variations in the seasonal amount of precipitation. This is only seen during wintertime at the Florida Caverns site.

The lag time of over two months and the lack of any relationship between rainfall amount and the increase in drip rate indicate a dominance of matrix flow relative to fracture/conduit flow at each site. The long residence time of the vadose seepage waters allows for an effective isotopic homogenisation of individual and seasonal rainfall events. We find no correlation between rainfall and drip water $\delta^{18}\text{O}$ at any site. The isotopic composition of drip water in both caves consistently tends to resemble the amount-weighted monthly mean rainfall input. This implies that the $\delta^{18}\text{O}$ of speleothems from these two caves in Florida cannot record seasonal cycle in rainfall $\delta^{18}\text{O}$, but are suitable for paleoclimate reconstructions at inter-annual time scales.

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