Geophysical Research Abstracts, Vol. 7, 07864, 2005
SRef-ID: 1607-7962/gra/EGU05-A-07864
© European Geosciences Union 2005

Modern drip water δ^{18}O variability in Crag Cave, SW Ireland: Implications for palaeoclimate studies of stalagmites

L. Baldini, F. McDermott and J. Baldini
University College Dublin, Ireland

A multi-year time series dataset of cave drip water and rainwater δ^{18}O sampled monthly at Crag Cave reveals a strong control by karst hydrology on drip water δ^{18}O and the extent to which drip waters record the δ^{18}O of precipitation. Data from an automatic weather station at the surface were used to calculate water excess (precipitation minus evapotranspiration) and identify periods of meteoric water infiltration. δ^{18}O values of monthly-integrated drip waters exhibit significantly less variability (–5.21 to –5.40 per mil) compared with those of monthly-integrated rainwater (-4.46 to -7.87 per mil) suggesting that seasonal climate signals in drip waters, and ultimately in stalagmites, are variably buffered by mixing in the unsaturated zone. Drip water δ^{18}O buffering can be quantified by comparing the range in monthly-integrated drip water δ^{18}O at each drip site to that of monthly-integrated rainwater δ^{18}O. The δ^{18}O range at monthly monitored drip sites represents 3-11% of rainwater δ^{18}O variability indicating strong attenuation of the seasonal signal. Drip rate measurements reveal significant inter- and intra-site variability, but when combined with drip water δ^{18}O, appear to be consistent with published hydrological classifications of cave drips (Baker et al., 1997; Smart and Friedrich, 1986). Two sites with drip rates classified as 'seepage-flow' exhibit almost no change in drip rate throughout the multi-annual monitoring period (0.074 – 0.078 ml/min and 0.052 – 0.056 ml/min) and are insensitive to water excess, suggesting a high storage component and efficient homogenisation of seasonal δ^{18}O changes. By contrast, drip rates at sites classified as 'seasonal drips' correlate well with water excess, and exhibit the greatest temporal variability in drip water δ^{18}O. Drip sites that show the greatest drip rate variability, classified as 'vadose' or 'subcutaneous flow' regimes, rarely deposit stalagmites because the drip water is typically undersaturated with respect to calcite, reflecting short residence times in the

overlying limestone bedrock. Such residence times can be quantified by the time lag between occasional ’spikes’ in monthly rainwater $\delta^{18}O$ and their appearance in the drip waters. These new data indicate that stalagmites deposited at ’seepage-flow’ sites are likely to preserve a $\delta^{18}O$ record suitable for lower resolution, multi-annual climate reconstructions. Alternatively, stalagmites deposited by ’seasonal drips’ may be suitable for high-resolution (e.g. micro-mill or ion-probe) O isotope analyses, because intra-annual variability in drip water $\delta^{18}O$ is more likely to be preserved.