Interpreting climatic signals from stalagmite trace element and isotopic records using simple geochemical models and growth rate constraints

HEATHER STOLL[1]* ANA MORENO[2], ISABEL CACHO[3], ANA MENDEZ-VICENTE[1], HAI CHENG[4] AND R. LAWRENCE EDWARDS[4]

[1]Dept. Geology, University of Oviedo, Oviedo, Spain (*correspondence hstoll@geol.uniovi.es)
[2]Instituto Pireneico de Ecologia, CSIC, Zaragoza, Spain (amoreno@ipe.csic.es)
[3]Dept. Geologia, Univ. Barcelona, Barcelona, Spain (icacho@ub.edu)
[4]Dept. of Geology, University of Minnesota, Minneapolis MN USA

Fully exploiting the climatic information from speleothem trace element and isotopic records requires a quantitative approach for resolving the multiple parameters influencing geochemical signals. For example, monitoring data and simple models show that the degree of prior calcite precipitation (PCP) – a prime contributor to variation in speleothem Mg/Ca, Sr/Ca, and Ba/Ca – is driven by both the drip interval as well as the degree of oversaturation of the drip with respect to $CaCO_3$ at cave pCO_2. In laboratory and monitoring experiments, the oversaturation state of dripwater has also been shown to affect oxygen isotopic fractionation in calcite.

To resolve these effects in natural cave settings, we present new data from hydrochemical monitoring and from comparisons of sets of coeval stalagmites from MIS 5 to MIS 1 from cave systems in a small geographic region which is expected to have uniform climatic forcing. In addition, the I-STAL model [1], is used to confirm the stalagmites with strongest and weakest sensitivity to drip rate variation in PCP. The I-STAL model is also used to compare the growth rate variations predicted from inferred saturation states using standard kinetics of speleothem growth [2] with geochronologically constrained growth rates. This approach elucidates the situations where partitioning of Sr is sensitive to growth rate.

[1] Stoll, Muller, Prieto (2012), *Geochemistry, Geophysics, Geosystems* **13**, doi: 10.1029/2012GC004183. [2] Romanov, Kaufmann, Dreybrodt (2008), *GCA* **72**, 423-437.