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Reconciling local and regional trends in stalagmite carbon isotopes - results from a case study at El Pindal cave, Spain

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Carbon isotope ratios (δ^{13}C) in stalagmites are influenced by multiple sources and complex processes that make their interpretation as a palaeoclimate proxy difficult and often ambiguous. If correctly interpreted, however, stalagmite δ^{13}C values have enormous potential as a proxy for past changes in vegetation and soil conditions, karst hydrology, and/or in-cave processes.

Here we present new carbon isotope data (δ^{13}C and ^{14}C) from three stalagmites from El Pindal cave, in northern Spain. Combined with data from a previous study (Rudzka et al., 2011), we explore trends in δ^{13}C and dead carbon fraction (DCF) over the last deglaciation and in the early Holocene, using a multi-proxy approach including trace-element concentrations, δ^{18}O, and $\delta^{234}U_{ini}$. We use the newly developed software CaveCalc (Owen et al., 2018) to evaluate the likelihood of different carbon sources and processes leading to the observed proxy values, e.g., prior calcite precipitation (PCP), S cycling in the overlying karst , and changes in soil pCO$_2$. Through comparison with regional climate reconstructions and carbon isotope records from other nearby caves (La Garma and La Vallina), regional and local trends in δ^{13}C and ^{14}C can be disentangled.

We find some evidence that morphology and growth rate correlate with the “baseline” value of DCF and $^{234}U/^{238}U_{ini}$ in some stalagmites from the same cave, suggesting a hydrological control on these proxies. Differences in hydrological routing of dripwater might explain contrasting trends found in stalagmites from El Pindal over the last deglaciation, pointing towards highly localised processes playing a dominant role in the modulation of these proxies. Regionally coherent trends in δ^{13}C and DCF over the last deglaciation and the early Holocene found for some stalagmites suggest that regional palaeoenvironmental reconstructions from stalagmite carbon isotopes are possible.

References cited:

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