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Calibration of cave climate proxies in Northern Spain through rainwater and dripwater analysis

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Trace element chemistry of stalagmites may offer a powerful complement to the more widely used stable isotopic measurements. On the northern coast of Spain we show that the oxygen isotopic composition of rainwater, measured in discrete 48 hour samples collected since Dec 2005, is highly correlated with NAO index and only a moderately correlated with rainfall amount. This relationship suggests that the region may be ideally situated for reconstruction of NAO variability without truncation of the speleothem record during NAO positive phases which elsewhere in Spain result in significantly lower rainfall. Coupling of isotopic and trace element ratios, many of which correlate to precipitation amount, may allow deconvolution of rainfall amount and rainfall source in this region. However, trace element proxies require calibration to assess the generic and site-specific influences over their variations. Here we describe studies of dripwater flow rate and dripwater chemistry in multiple caves along a transect from the coast to the highlands across various land uses from pasture, developed, to undisturbed native forest to identify the processes responsible for variations in dripwater and stalagmite trace element ratios. All caves in the study occur in the massive non-dolomitic limestones of the Carboniferous Barcaliente formation.

Short lag times between precipitation events and increases in dripwater flow indicate short residence times in the aquifers feeding the dripwater system. In the two caves underlying pastures, rapid changes in concentration of P, N, and K, associated with fertilization, confirm short residence times in the aquifer. Sea salt aerosols are dominant source (80%) of Mg in the coastal cave but minimal for other elements like Sr

and Ba; the influence of aerosols drops off exponentially with distance from the coast. In dripwater timeseries from single drips in a given cave, Ca concentration and trace element ratios show strong evidence of temporal variations in the degree of prior calcite precipitation. However, prior calcite precipitation cannot explain all differences in chemical ratios between various drips in a cave or between different cave systems. We will present further study of the role of different land use and hydrology on dripwater chemistry.