Present-day calcite deposition in two caves of N Spain (Kaite and Cueva Mayor): Factors affecting calcite growth and fabric

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Contemporary investigations of present-day calcite forming processes in caves, and their relationship to specific environmental factors such as precipitation and temperature, are a key task for interpreting the paleoclimate signals recorded in the speleothems. This contribution analyzes the variability in the fabric and growth rates of present-day calcite speleothem deposits in two selected karst systems of N Spain: Cueva Mayor (Atapuerca) and Kaite (Ojo Guareña). The area is a key region for understanding the evolution of the European climate because its geographic position set between North Atlantic, Mediterranean, and North African regimes.

A multi-year continuous monitoring record is available for these sites. Short time scale (seasonal) and inter-annual variations in drip rate and chemistry have been investigated. Drip water discharge is continuous in time but rates at which it occurs are variable and highly dependent on the site and the patterns of precipitation. All the monitored points are oversaturated for $CaCO_3$ and seasonally invariant cave-air pCO_2 values have been measured. Present calcite deposition is also continuous in time, but reflects intra-annual variations in the crystallographic fabric (columnar, fibrous and dendritic) which interestingly correlated well with drip rates. Ca ratio variations (e.g. Mg/Ca, Sr/Ca, Ba/Ca) in drip water correlate with calcite growth rate and fabric.

Columnar fabric appears when drip rate is constant, then the crystals show same orientation, flat faces and few crystal defects. As drip rate increases crystal defects and porosity increase as well (fibrous fabric). When drip rate is highly variable calcite crystals are constituted by flat face blocks miss-oriented between one to each other. Latest presents the higher Ca ratios.

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Nd isotopes in modern and fossil bones – Tracers for provenance and diagenesis

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REE are ingested with the diet and, given a REE content of 320±50 ppb (n = 10) in recent bones, the $^{143}Nd/^{144}Nd$ ratio of the recent skeletal apatite can be used as a tracer of the bedrock geology or water mass to evaluate migration of extant vertebrates. However, REE are enriched during diagenesis and recrystallisation by up to 5 orders of magnitude and *in vivo* ε_{Nd} values in fossils are overprinted.

REE patterns of fossil bones reflect those of the diagenetic fluid and allow to reconstruct porewater compositions. As such, the REE patterns of fossil bones and teeth are important tracers for taphonomy, diagenetic milieu and provenance. However, REE patterns can be biased by fractionation processes during REE incorporation into the apatite crystal lattice. This is not the case for the ε_{Nd} value, which accurately reflects that of the early diagenetic fluid in which the bone or tooth fossilized.

The Nd isotopic composition of a fossil bone is often similar (within analytical error of ±0.3 ε_{Nd} units), despite large Nd concentration gradients of 10^1 to 10^3. Bones from autochthonous fossil assemblages have only a small variation of ε_{Nd} values (~1 ε_{Nd} unit), while specimens from 20 different marine and terrestrial fossil sites have a total range of ε_{Nd} values from –13.0 to 4.9 (n = 90). ε_{Nd} values of fossil bones and surrounding sediment are usually similar, indicating *in situ* fossilization in the presence of sediment influenced diagenetic porefluids. Differences in ε_{Nd} values between skeletal remains and embedding sediment may indicate fossil reworking and/or a REE uptake from a diagenetic fluid with non-sediment derived ε_{Nd} values; e.g. fossil shark teeth often have seawater-derived ε_{Nd} values.

The Nd isotopic composition of fossil bones and teeth is thus a valuable taphonomic tracer that allows inferences to be made on the diagenetic conditions and hence enables determination of fossil provenance and detection of fake fossils.