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Calibration of the $\triangle$47 for modern marine mollusks

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Oxygen isotope measurements of fossil carbonates from various environments form the basis of a classical method of paleoclimatic temperature reconstruction. The main uncertainty of this approach is its sensitivity to the oxygen composition of water from which mineralization occurs ($\delta^{18}O_w$), which may fluctuate significantly through time and is often difficult to constrain precisely. Clumped isotope carbonate paleothermometry is an alternative isotopic method applicable to the same type of samples, which requires no independent information on $\delta^{18}O_w$.
Here, we present new calibration data regarding clumped isotopes in five species of marine mollusks (four calcitic bivalves species and one aragonitic gastropod species). We use three species of oysters: (a) deep-dwelling Neopycnodonte cochlear from a submarine canyon in the western Mediterranean, formed at a constant temperature of 13°C; (b) a tropical oyster (Saccostrea cucullata) from Kenyan waters with a year-round constant temperature of ~27°C; (c) mid-latitude Crassostrea gigas from Normandy, on the Atlantic coast of France, for which sub-sampling intervals correspond to winter (average seawater temperature of ~9°C) and summer (average seawater temperature of ~19°C), based on sclerochronological analyses from mark and recapture experiments. We also sampled Pectens (Adamussium colbecki) from Antarctica waters at -2°C, and several specimens of the gastropod species Turritella communis collected along the French Mediterranean coast, with subsamples corresponding to the summer period (T ~17°C). All mollusks were sampled alive from sites where temperature was carefully monitored. Combined with our schlerochronologic approach, this allows for reliable comparisons between environmental parameters and the growth and isotopic composition of each molluscan shell.
Our results are consistent with a strong correlation between seawater temperature and Δ_{47} for all samples except for the winter samples of the French oysters, which yield statistically lower Δ_{47} values than expected and for the (aragonitic) turritelles, which yield higher Δ_{47} values than expected. The former observation may be related to metabolic fractionation effects and/or strong thermal controls on winter-time calcification, as shell growth rates decrease spectacularly during the cold season. Regarding turritelles, it is too early to conclude whether the observed deviations could be due to a systematic specific bias. The excellent consistency between our observations and recent Δ_{47} calibration data on foraminifera supports the notion that many of these different species obey a single relationship between calcification temperatures and clumped isotopes.