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Frontiers for the use of Δ47 and Δ48 measurements to understand organism-environment interactions in bivalve molluscs

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Clumped isotope measurements of carbonate minerals can produce high quality constraints on paleotemperature and hydroclimate in both terrestrial and marine environments. Reliable paleoclimate reconstructions are necessary for understanding how the biosphere responded to past environmental perturbations as well as the circumstances surrounding important evolutionary events such as mass extinction. Biotic responses to climate change in the geologic past are complex to address and require a variety of proxies for paleophysiological traits. Clumped isotope measurements of skeletal carbonate may reveal a distinct set of paleobiological information not accessible through other paleontological methods, thereby expanding our toolkit for investigating paleophysiology. Many bivalve shells may be good archives for studying organism-environment interactions: their calcium carbonate shells contain at least two layers that may record biologically driven isotopic fractionations (BioDIFs). Recent work demonstrated how measuring Δ_{47} and Δ_{48} in these different shell layers could be used to interpret specific shell precipitation mechanisms. Even at a lower level of specificity, compositional differences between shell layers can be traced through space, time, and phylogeny as a physiological trait in their own right. Here, we summarize several datasets including $\delta^{18}O$, $\delta^{13}C$, Δ_{47}, and Δ_{48} measurements on a selection of modern and late Maastrichtian age bivalves, cumulatively representing 5 of 6 major clades of class Bivalvia. These data show that genus- and species-level diversity of BioDIFs is much greater than previously thought. Isolating members of several cosmopolitan genera allows us to preliminarily investigate the influence of both phylogeny and environment on BioDIFs. We will discuss the implications of these findings for both the quality of paleoclimate records and the opportunities they represent for bringing stable isotope measurements to bear on paleophysiology.