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Carbonate triple oxygen isotope analyses of brachiopod shells

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The $^{18}\text{O}/^{16}\text{O}$ ratio ($\delta^{18}\text{O}$) and the clumped isotope composition (Δ_{47}) of marine carbonates are widely used proxies of Earth's past seawater temperature. However, kinetic isotope fractionation effects occurring during carbonate precipitation and diagenesis complicate their use as climate proxies. Specifically, the failure to identify disequilibrium precipitation and post-depositional alteration in the investigated samples could lead to biased temperature estimates [1,2]. The identification of these effects using the $\delta^{18}\text{O}$ and the Δ_{47} proxies are not straightforward. The triple oxygen isotope method, that is, the combined analyses of the $^{18}\text{O}/^{16}\text{O}$ and the $^{17}\text{O}/^{16}\text{O}$ ratios, expands the traditional oxygen (and clumped isotope) scheme by another dimension, thus providing information on the nature and extent of kinetic effects involved in carbonate formation and the subsequent diagenetic processes [2].

In this study, we measured the triple oxygen isotope composition ($\Delta^{17}\text{O}$) of modern and fossil brachiopods. Brachiopods are an important group of calcifiers because they are abundant in the sedimentary archive and present since the Cambrian. We show how triple oxygen isotope analyses can help identify and disentangle kinetic effects and diagenesis and ultimately provide a more accurate palaeotemperature estimate.

[1] Bajnai et al. (2018) Sci Rep

[2] Wostbrock et al. (2020) GCA