



EGUsphere, referee comment RC3  
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## **Comment on egusphere-2022-1144**

Anonymous Referee #3

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Referee comment on "Multi-proxy assessment of brachiopod shell calcite as a potential archive of seawater temperature and oxygen isotope composition" by Thomas Letulle et al., EGU Sphere, <https://doi.org/10.5194/egusphere-2022-1144-RC3>, 2022

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The study by Letulle and colleagues provides new geochemical data from modern brachiopod shells ( $\delta^{18}\text{O}$ ,  $\Delta 47$  and Element/Ca ratios) to test their reliability as archive to reconstruct ambient temperatures and seawater  $\delta^{18}\text{O}$ . The novelty of this study is a revised equation of oxygen isotope fractionation that slightly differs from the previously published ones by Brand et al. (2013, 2019) by using a linear relationship for temperatures below 50°C. Further, the calibrated area extends to polar latitudes with MAT below 0°C. The authors discuss the accuracy and precision of the new equation in comparison to other carbonate-based paleothermometers by using the published brachiopod-derived oxygen isotope data of Bajnaj et al. (2018). In addition, the brachiopod-shell  $\Delta 47$  values correlate with growing temperatures, but with an offset relative to other biogenic and abiogenic calcium carbonate minerals. The Element/Ca ratios instead do not show meaningful relations with temperatures.

The results of Letulle and colleagues supplement the results of previous studies and are thus a contribution for the improved development of brachiopod shells as a paleoclimate archive. Brand et al. (2019) delivered alternative fractionation equations of oxygen isotopes based on an extensive data set of modern specimen. Bajnaj et al. (2018) identified kinetic effects of biomineralisation of brachiopods by the analysis of clumped isotopes, and Ullmann et al. (2017) identified the kinetic effects to differ taxonomically among different orders of brachiopods especially the suborder of Terebratulidina.

The here supposed combined approach of using brachiopod-shell-derived  $\Delta 47$  and  $\delta^{18}\text{O}$  delivers growing temperatures and seawater  $\delta^{18}\text{O}$ , and has a good potential for the reconstruction of past environments, particularly in epi-continental and shallow marine settings where other carbonate archives as well-preserved foraminifera are rare. I recommend the study for publication. In the following are some comments the authors should address in a revised version.

- Comparison of the new equation of the oxygen isotope fractionation with those of Brand

et al. (2019). Both equations are similar in the temperature range between 10-25°C, but differ in the low-temperature field (<10°C). Since the Brand et al brachiopod-data set is by far much better constrained by data points, the authors should provide a more in-depth discussion about causes of the offset. Further, they should strengthen their arguments why it is necessary to introduce the new equation, and why it shall be an improvement.

- In this context, please also indicate the MAT range covered by the Bajnaj et al. 2018 brachiopod data set (line 281).
- The supposed sampling procedure avoids specialized parts of the shell as umbo, edges, muscle scars, primary layers. However, Ullmann et al. (2017) observed additional significant taxon-specific ranges in their intra-specific high-resolution oxygen isotope data. How has this observation an effect for the results of this study? Is intra-specific variability smoothed by the sample size? Which degree of uncertainty introduce specimens of the suborder Terebratellidina to the fractionation equations? Please comment on this.
- The Jurassic example is not well executed and not the scope of this study. New and very few data points are introduced first time in the discussion. I recommend the removal of this part of the manuscript, since its focus is on modern brachiopod taxa.
- Please, explain all parameters and abbreviations in Supplementary Table S1.

Please check the manuscript for spelling errors, here are some I spotted:

- "Rhynchonellida" in Fig. 4 – revise spelling two "l"
- Line 86: Delete "previous"
- Line 98-99: incomplete sentence
- Line 375: Enter a space between "regression derived"
- Line 532: spelling of "isotopic fractionation"
- Typos in supplementary File S3 (Sheet Description)