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Biogeosciences Discussions

Interactive comment on "Planktic foraminiferal shell thinning in the Arabian Sea due to anthropogenic ocean acidification?" *by* H. de Moel et al.

H. de Moel et al.

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We'd like to thank both referees and dr. Gattuso for the thorough attention they've given our paper and their constructive comments.

Comment from dr. Gattuso: Dr. Gattuso suggests to add the data on which the paper is based as supplementary information.

Authors: We agree that this will benefit research in the area of the impact anthropogenic ocean and the impact it may have on organisms. We will therefore submit an excel file in which the data is displayed with the final submission if the editor agrees.

Comments by Anonymous Referee #2.

Referee #2: The referee points out two tests that could be done in order to make the findings of our manuscript stronger. The first one is that 14C analyses of deeper sediment, out of reach of bioturbated post-industrial influence, would make the case stronger.

Authors: We agree with the referee (and referee #1 who also points this out) that additional 14C analyses would add to the discussion of our data. This would however, as the referee already indicates, take considerable time, particularly selection of sufficient thin and thick shells (about 800 shells from the used size fraction are needed for a proper analysis) is time consuming. In addition, the 14C analyses presented in the paper were from the core-top sample, which consisted of much more material compared to the samples from the box-core, from which material was used for the weight analyses of the upper 25 cm. It's therefore very likely that there is not enough material (at least 800 thin and 800 thick shells) to perform the requested analyses. However, we agree for future work that it is absolutely worthwhile to look at the 14C signal below the mixed layer.

Referee #2: The second test the referee points out is related to the depth of the mixing layer, which is quite large, especially considering the centennial variability shown from the same site by Jung et al. (2002). Additional 14C analyses from shells in the mixed layer would could further evidence that the mixed layer is indeed ˜15 cm as found using the lead analyses (or not of course).

Authors: Jung et al. (2002) indeed show centennial scale variation from a core at the same site. This is in our opinion however not necessarily in contradiction with the large mixing layer found in this study. While bioturbation will smooth any signal present, it will not completely remove it so might still be detected. We agree though that 14C analyses from shells in the 'supposed' mixed layer could support the mixing depth as calculated by the lead analyses. Unfortunately, we have the same problems with respect to time and material availability as described above so are unfortunately unable to perform such tests for this manuscript.

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Comments by Anonymous Referee #1

Referee #1: Besides agreeing with the first comment of referee #2, referee #1 has some additional comments and suggestions. The first one relates to the size distribution of the thick and thin walled shells and whether this data could be added as a figure.

Authors: With our final submission we will add all our data in the supplementary information. The size distribution of the thick and thin foraminifera will be included there as well. We believe that adding a figure showing this data in the main paper will put too much emphasis on this aspect compared to other data, while it's not as important by itself. It would be of great importance if the size distribution was different but they are actually surprisingly equal as can be seen in the table below.

class - size fraction - % of total shells

Thin - 250-300 - 67.1% | Thick - 250-300 - 66.0%

Thin - 300-355 - 22.5% | Thick - 300-355 - 23.3%

Thin - 355-400 - 9.2% | Thick - 355-400 - 9.1%

Thin - 400-500 - 1.1% | Thick - 400-500 - 1.5%

Referee #1: The referee further asks if it is possible to add some photo's displaying the translucent nature of the shells for readers who are not as familiar with foraminifera.

Authors: While we are hesitant to add more figures to the paper we do have some photographs of thin and thick shells that we will add to figure 1 of the paper. Because these photos have been made through a simple binocular microscope, which can only focus on one plane at the time, the picture is not as sharp as we would like. It does however illustrate well the translucent vs. milky white appearance of the thin and thick shells, respectively. Two panels have been added to figure 1 with these images and will thus be included in the final submission

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Referee #1: The third comment of the referee hits the nail on the head when pointing out the biggest problem of our data is the surprisingly good agreement of contemporary shells (trap and tow) with shell weights found in the mixed layer.

Authors: Indeed we had expected shell weights in the trap and tow to be closer to the weights of our thin shells. The weights are, however, in between the weights of our thick and thin shells. While the weights of shells produced during the inter-monsoon (so no upwelling) are close to the weights of our thick shells in the core-top, the weights of the shells produced during the monsoonal period are certainly not as light as the thin shells in the core-top. The implication of this observation is indeed problematic (and the reason we don't formulate a stronger conclusion). Perhaps the fact that the trap represents (almost) a single year whilst the core top represents an average of many decades (if not more) may explain this discrepancy. It could be that the local conditions during the mooring were not as acidic as other years (due to e.g. currents, upwelling strength).

Referee #1: Table 2 - not clear what '# of samples' refers to.

Authors: The '# of samples' indeed refers to the amount of analyses of which the averages are given in the table. The heading for the final submission has now changed into '#of analyses averaged' in order to make this more clear.

Referee #1: Figure 2 - why not plot the weights of the different size fractions?

Authors: We agree and have now included the points of the different size fractions as grey diamonds in Figure 2. As numbers given in the text refer to the 250-355 um fraction weights, the averaged weights are still prominently in the figure as black dots as well.

Referee #1: Page 1819 (line 16) - the authors compare their estimated influence of [CO3=] on shell weight with the dissolution study of Broecker and Clark; I do not see why this is relevant.

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Authors: The referee is correct in stating that it is not so relevant to compare our estimate of the influence of [CO3=] on weight with Broecker and Clark (2001) as our estimate is not due to dissolution but reduced calcification. The other two examples mentioned in the same line are in that respect much more relevant. We have therefore removed this in the manuscript.

Referee #1: The mixing depth inferred from core 905B seems rather large. It may be useful if the authors plotted the Pb profile in support of their modeling.

Authors: The calculation of the mixing depth is indeed an important point with respect to the data discussion in the paper. The proper place to put it would be in Figure 2, which, however, already contains a high amount of data. We will therefore not add it there but will add it as supplementary information data file with the final submission, including explanatory text regarding the derivation of the mixing depth and modeling details.

References

Broecker, W., and Clark, E.: An evaluation of Lohmann's foraminifera weight dissolution index, Paleoceanography, 16, 531-534, 2001.

Jung, S. J. A., Davies, G. R., Ganssen, G. M., and Kroon, D.: Centennial-millennial scale monsoon variations off Somalia over the last 35 kyr, in: Tectonic and Climatic Evolution of the Arabian Sea Region, edited by: Clift, P., and Kroon, D., Journal of the Geological Society London, London, 341-352, 2002.

Interactive comment on Biogeosciences Discuss., 6, 1811, 2009.