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Biogeosciences Discussions

Interactive comment on "Impact of seawater pCO_2 changes on calcification and on mG/cA and sR/cA in benthic foraminifera calcite (*Ammonia tepida*): results from culturing experiments" *by* D. Dissard et al.

Anonymous Referee #2

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This paper is a valuable contribution to the literature on both calcification response to changing carbonate chemistry, and trace-element incorporation as a function of carbonate chemistry.

My final rating, "accept subject to major revisions" I hope will not be taken too negatively, but I think the revisions required are substantive enough not to be "minor." There's no category for "accepted subject to 'moderate' revisions" which is how I would rate this paper.

A limitation, which may be beyond the scope of the current contribution, is that the experiment only examined two values of pCO2. The values chosen also represent extremes, at 120 ppm and 2000 ppm. Perhaps this is a good place to start, but it would be good to see experiments on foraminifera grown in conditions that really have applied in the past, and/or are likely to apply in the near-future. Perhaps these will be the subject of further experiments.

A significant omission, though, is any indication of a "control" for A. tepida calcification and Sr/Ca and Mg/Ca at the ambient (probably mean) natural conditions in which it grows in the wild.

Similarly, what are the conditions, in terms of pCO2, temperature, and salinity where the specimens were collected? The natural range of conditions the foraminifera experience should definitely be added to the paper. As an intertidal environment, the sampling location probably has quite large diurnal as well as seasonal variabilty.

There is no indication of the statistical significance of the relationship between size-normalized shell weight and carbonate ion (Figure 4c), and this should be added before the paper is published. Also this relationship seems to depend on the relationships between shell weight and diameter (Figs. 4 a and b) which themselves seem to have quite a bit of scatter. Can the null hypothesis - that's there's no relationship between shell weight and carbonate ion concentration – be rejected in this data set?

It's not clear why the particular combination of temperature, salinity, and pCO2 conditions used in the study were chosen. If the object of the experiment was evaluate the impact of seawater pCO2 changes, as the title suggests, why not hold temperature and salinity constant and vary carbon dioxide through a more extensive set of intermediate values between 120 and 200 ppm? I'm not suggesting the authors go back and do all this before this paper is published, but rather to see more discussion of the rationale for the experimental design. It would help other investigators setting up similar experiments (which I think this paper will inspire).

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The section on cleaning procedures notes that “specimens were removed from the reagent directly after complete bleaching, in order to avoid dissolution of the final, (often thinner), chambers.” This raises a concern that the bleaching procedure may have already dissolved some of the final chambers. Is there a way to establish that dissolution is not induced by the bleaching procedure itself? For example, is calcein stain present in the water in which the shells are bleached after the bleaching? Has the pH in the solution changed before and after the bleaching? These might be quick and straightforward ways to check.

The discussion notes other studies which document changes in foraminiferal shell weight in response to natural variations (temporal and/or spatial) in seawater carbonate chemistry, notably the Barker and Elderfield 2002 Science paper. However, since the Barker and Elderfield paper (and probably after this paper was submitted), other evidence of similar (at least in sign) sensitivity to changes in seawater [CO3=] in planktonic foraminifera has been published from the Southern Ocean (Moy et al., 2009) and should be cited here. Similarly, work also in Biogeoscience Discussions, suggests a reduction in planktonic foraminiferal calcificatation in the Arabian Sea since pre-industrial times (de Moel et al., 2009).

Other comments:

It’s not clear why, in Figure 7, Sr/Ca is plotted as a function of pH rather than as a function of carbonate-ion concentration and/or as a function of pCO2. Presumably one would want to compare Sr/Ca in the planktonic foraminifera O. universa and G. bulloides directly to the results obtained for A. tepida here, so why not plot their Sr/Ca ratios in the same variable space?

A few minor quibbles and typos:

Fix the capitalization of Sr, Mg, and Ca in the title.

Page 3774, Line 20: is that meant to be “over a 63 μm mesh?” rather than “630 μm?”

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Page 3784, Line 21: I think that should be “therefore” rather than “therewith.”

References:

de Moel, H., Ganssen, G. M., Peeters, F. J. C., Jung, S. J. A., Brummer, G. J. A., Kroon, D., and Zeebe, R. E., 2009, Planktic foraminiferal shell thinning in the Arabian Sea due to anthropogenic ocean acidification?: Biogeosciences Discuss., v. 6, p. 1811-1835, http://www.biogeosciences-discuss.net/6/1811/2009/.

Moy, A. D., Howard, W. R., Bray, S. G., and Trull, T. W., 2009, Reduced calcification in modern Southern Ocean planktonic foraminifera: Nature Geoscience, v. 2, p. 276-280, doi: 10.1038/ngeo460.

Interactive comment on Biogeosciences Discuss., 6, 3771, 2009.