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Interactive comment on "Response of benthic foraminifera to ocean acidification in their natural sediment environment: a long-term culturing experiment" *by* K. Haynert et al.

Anonymous Referee #4

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General comments

I have been asked by the editor to review this manuscript. The authors present a long-term study manipulating four levels of pCO2 (430-3247 μatm) on a foraminiferal assemblage contained in sediment from an environmentally highly variable habitat in the southwestern Baltic Sea. The approach to culture foraminifera in a more 'natural' microenvironment is generally a very good idea and a new approach.

Generally this manuscript has been prepared with emphasis on detail and is well-written. The overall question on the benthic foraminiferal response in sediment environment to changes in pCO2 is relevant for the scientific community, specializing in

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marine benthic communities and global change science.

Despite this, I see major problems with the experimental design in answering the target questions (which are outlined below). Furthermore the statistical tests have only been applied on one parameter (test diameter). Conclusions that growth, mortality and reproduction were not affected by pCO2 increase cannot be made based on this dataset. Statistics were shown on test diameter between pCO2 treatments but statistics on the other results densities and reproduction are not shown. Reproduction events in the high pCO2 treatments might have biased results on final test diameter measurements. Population density data (Table 1-2) of living A. aomorensis at the end of the experiment are not logically presented.

Because BG has an Impact Factor of 3.7, I suggest re-writing and re-submission of the data set under a different conclusion to this or another journal.

Specific comments:

In particular: I like to raise three issues to the attention of the editor regarding the experimental design which are of importance evaluating the results of this study:

A.) The saturation state in the pore water was much higher and differed significantly from the "manipulated" values in the water column by pCO2 aeration. Pore water pH was not monitored continuously during the study, and only measured at the end. So we do not know if changes due to microbial activity (natural, feeding) on pore water pH occurred. In my opinion the authors cannot conclude that the sediment chemistry did create a microhabitat which supported growth independently from highly elevated pCO2 conditions over the course of the study. Another replicate just for sampling continuously pore water would have been needed to justify that manipulated pCO2 aeration did receive the aimed results at the sediment water interface over the entire period of manipulation.

B.) During the experiment the cultures have been additionally feed weekly with living

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microalgae which influences pH due to respiration and production especially on a daily cycle. So diurnal variations might have been large potentially because of accumulated algae in the cultures and no cleaning. Microalgae might have even been fertilized in the elevated pCO2 treatments enhancing photosynthetic production.

C.) Salinity values are very low at 15-16 ppm and make comparison to other studies difficult. No explaination is provided why those have been choosen.

Specific comments in order:

Abstract P 9524, Line 12 please add that there is no significant effect between the different pCO2 treatments and add according statistics in Table4.

Line 22 please indicate in which treatment and approximately how many specimen did show dissolution features

Line 25 Please indicate how large the species specific effect is and give % to compare between species, high Mg-Calcite is the most soluble form but both calcite types are likely to be affected at such extremely low omega reported here

P 9525 Line 9-11, The introduction is relatively short, it could benefit by shortly reviewing the content of studies listed here and introducing work from Japanese co-workers on pCO2 and Foraminifera which are cited later in the discussions part

P 9533 Line 1-3, Statistics part is not well presented, I doubt that raw data was sufficient to meet the assumptions of ANOVA (normality, equal group variances)? Because density data (living and dead specimen) are given in percentages those data usually needs to be transformed, it is inconsistent that Table 4 (Page 9565) does not show all raw data collected but it is stated here that statistics were performed on all raw data. The results of the statistics in Table 4 should be referred to in the results section and then the numbering of the Tables adapted. Statistics on test diameter and population densities are difficult because you report various reproduction events in the cultures. Did you try to see if results are different if you exclude cultures where reproduction had

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occurred? Within one to two month offspring can reach sizes close to adults.

Page 9533 -9538 Results section lacks clarity and does not address the data presented in the results well enough, I suggest to re-structure and to start on carbonate chemistry, and then statistical results followed by percent changes and general observations in the measured parameters

Page 9547 Line 24 The conclusion cannot be made that “Growth, reproduction and mortality of A. aomoriensis were unaffected by elevated pCO2 from the presented dataset.

Page 9556 Table 1 can be improved by summarizing incubation time, give incubation time as 0-2 month, 3-4 month and 5-6 month so the results are presented in a clearer way

Page 9557 – 9564 Table 2 Please give mean % values of data by pCO2 treatment and write that the Table summarizes results of 3 replicates , this will make the Table clearer and your results will stand out better

Page 9567 Figure 2 does not related to the hypothesis and shows a rare species in the cultures, it should be omitted or put in the supplement

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