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Biogeosciences Discussions

Interactive comment on "Effect of carbonate ion concentration and irradiance on calcification in foraminifera" *by* F. Lombard et al.

F. Lombard et al.

fla@aqua.dtu.dk

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"The experimental conditions for the carbonate ion concentration seem to have been chosen in two clusters, low (71-233 micromol/kg) and high (455-566 micromol/kg). When looking into the data of the final shell weight, these two clusters cannot be easily identified. In other words is there such a strong relationship?"

Response: One could argue that we used four different carbonate ion concentrations: ambient concentration (233 μmol kg-1), about twice the ambient concentration (455, 504, 566 μmol kg-1), ca. half the ambient concentration (139 and 124 μmol kg-1), and

a quarter of the ambient concentration (71.9 μmol kg-1). The fact that the data appear as two clusters in the figure is due to the fact that ambient, ambient/2 and ambient/4 are within close range each other whereas 2x ambient is far from current concentration. When considering the final shell weight (Fig 1A&B, Page 8594, line 12-16), the different conditions are well represented under high light (HL) (with the exception of 504 μmol kg-1 condition) and result in three clusters (72-139, 233-504 and 455-566 μmol kg-1) but only two clusters exist under low light (LL) . The differences between these clusters were significantl (Table 2 "Test within LL and HL"). The difference between HL (r2= 0.73) and LL (r2=0.33) is shown in Fig 2B. We therefore agree with the reviewer that the effect of carbonate ion concentration is much lower in low light.

"In the figures, regression lines are plotted for all individual data sets. Does the r2 of the regressions justify further interpretation and conclusions about the "slopes"? Seven data points with six degrees of freedom need and r2 of >0.5 at the 95% and >0.7 at the 99% confidence level, respectively to be significant. At least one new dataset (Fig.2 G.sacculifer 700micrometer LL) does not fulfill the condition to be significant at the 95% confidence level and should be disregarded for further interpretation as there is no relationship between mean shell weight and carbonate ion concentration."

Response: We have to differentiate two different test that respond to two different questions: "does the model used significantly represent the data set (via r2 analysis which represent the goodness of fit and part of variance explained by the regression)?" and "does the results show that there is an influence of carbonate ion concentration (via a F test that estimate if the slope is significantly different from zero by taking in consideration the uncertainties of the regressions). The slope analysis tests are then justified in this way. However we agree the reviewer that in the case of low light conditions (Fig 2B), because of the data set variability the relationship used is not significant and then we cannot justify the second test (which is not the case of all other relationships in the manuscript). The figure caption and the manuscript body have been modified in this way. We want however to precise that this final shell weight analysis (Fig 2) was

conducted in order to present a comparison with previous datasets, but is biased by field-grown contribution to shell mass. This is why calculations of calcification rates were done (Fig 3), which allow considering all individuals (and then increasing the degree of freedom and significance of statistical tests). This is now more clearly stated in the result section and the affirmation that "the final shell weight as well as the calcification rate clearly depended on the concentration of the carbonate ion" is now nuanced in this regard.

Specific comments: "p. 8593, 24-26 maybe I do not get the authors' point clearly, but: is final size not a direct function of delta t?"

Response: Not necessarily: delta t represents the time interval between collection and gametogenesis. In the case of large (and old) specimens when collected, they usually have a short delta t but still have the potential to reach rather large final size. On the contrary, for small (and young) specimens at collection, in few cases, some did not perform well but survived a large time intervals and ended with a small final size despite a large delta t.

"p.8594, 1-4 These two sentences should be checked for grammar, they do not read well."

Response: These two sentences are now modified

"23 Figure 2 shows weight only and not length." Authors probably mean fig 1?

Response: Yes this is right Figure 2 only shows weight for different for different ranges of shell size. The text has been modified accordingly.

26 "for a similar size"

Response: This has been changed to "within similar size ranges".

p. 8596, 14/15 add "of" between "rate" and "calcification"

Response: This has been changed.

p. 8597, 20-29 see my comments above

Response: The wording was changed accordingly to the comment above.

p. 8598, 7-11 "de Moel et al. present the weights for G. ruber: modern, thin individuals 10 microg, thick preindustrial ones 13 microg, LGM 15 microg all data from sediments, recheck the calculated percentages"

Response: We took the data from Fig 2 of de Moel et al. (2009) with "modern" weight around 12 μg, preinductrial around 13.5 μg and 15 μg for LGM (those data correspond to the percentages cited in the manuscript). Despite the fact that thinner shell maybe younger than thicker ones, other processes (mostly seasonality) discussed in de Moel et al. (2009) may have resulted, at least in part, in the difference between thin and thick shells. We chose to not consider this information and focus only on the average weight (thin and thick together) difference between present, preindustrial and LGM conditions as presented in Fig 2 of de Moel et al. (2009).

20 change one of the two "numerous" into "many"

Response: This has been corrected.

A question in general: Is it possible that the gam-calcite hides potential effects of reduced calcification of earlier formed carbonate, specifically for G. sacculifer?

Response: Gam-calcite may have masked potential effect of reduced calcification in both O. universa and G. sacculifer. However, this would imply that carbonate ion concentration affect gam-calcification and primary and secondary calcification differently. This is currently unknown. In addition, the proportion of gametogenic calcite in fully grown G. sacculifer is unkown. This information has been added in the revised version of the manuscript.

The paper further could be improved by some grammar and language polishing of a native English speaker.

Response: The manuscript is now corrected by a native English speaker

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