

## ***Interactive comment on “Size-dependent response of foraminiferal calcification to seawater carbonate chemistry” by Michael J. Henehan et al.***

### **Anonymous Referee #2**

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In this manuscript, the authors use a combination of laboratory culture experiments, plankton tows, fossil shells and modeling to examine drivers of size normalized weight in foraminifera. They focus efforts on the species *G. ruber*, and identify the importance of shell size and chamber number as predictors of size normalized weight, while also reaffirming the roll of carbonate chemistry, both during growth and in the depositional environment. This paper represents an important contribution to understanding the mechanisms of and interpreting differences in foraminiferal weight in the fossil record. Overall the paper is well structured and well written. I have highlighted below a few areas where the authors make some broad assumptions in their reasoning, which if addressed directly, could further strengthen this manuscript.

1) Henehan et al. have, in their discussion, put forward some interesting ideas about the mechanisms underlying observed trends in calcification intensity in different sized

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G. ruber. However, the extrapolation of this to all foraminifera (small/large, planktonic/benthic, juvenile/adult) is in my opinion overreach. This line of reasoning seems to equate adult foraminifera from small species with earlier ontological stages in larger species. However, it is unlikely that size alone is a meaningful determinant of physiology and calcification mechanisms across such a diverse group of foraminifera and ontological stages. I would recommend that the authors either remove these sections on pages 9-10 (and Fig. 5) or rework this discussion to better support and address these assumptions.

2) The novel approach presented in the methods for quantifying calcification intensity in cultured foraminifera could be widely used, but raises some questions. This metric relies on the assumption that foraminifera of a single species from a certain locale will have a consistent size/mass relationship, such that an initial mass can be predicted from size. However, the authors show that environmental conditions (carbonate chemistry) can significantly alter the size/mass relationship. This would seem to contradict the underlying assumption of consistent initial size/mass. This apparently contradiction could be made explicit and addressed.

For example: Was anything done to constrain the environmental conditions of the foraminifera used to establish an initial size/mass relationship? How do the conditions at collection of these samples compare to those at the collection of cultured foraminifera? The  $R^2$  of the initial relationship is also not very high (0.61), suggesting quite a lot of variability in individual foraminifera size/mass – could Henehan et al. give an indication of the uncertainty this would introduce into the calculation of calcification intensity in a cultured foraminifera?

Minor: The authors show that size-dependent calcification intensity is responsive to carbonate chemistry. Given this, they may wish to add an acknowledgment or brief discussion of the existing literature on how various environmental factors, like temperature, can impact shell size and growth rate (e.g. Schmidt et al., 2004 or Lombard et al., 2010).

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Page 13, Line 14: edit “change changes”

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Interactive comment on Biogeosciences Discuss., doi:10.5194/bg-2016-459, 2016.

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