

## ***Interactive comment on “Experimental evidence for foraminiferal calcification under anoxia” by M. P. Nardelli et al.***

### **Anonymous Referee #1**

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The manuscript by Nardelli et al. is an interesting submission that suggests a few foraminifera calcified while being exposed to anoxia. While some of the methods used are adequate, not all are compelling and some are worrisome. Further, such small numbers need to be reported more openly because truly the results are not that convincing. Specific points are listed below.

The abstract must be more quantitative. In particular, it needs to specify the very low percentage of specimens that added calcite under anoxia. The percentages are really quite low. That, when taken with the small populations, makes the argument not very convincing. For experiment 1 (*Ammonia tepida*), 1-4% added calcite ( $n=50$  per treatment). How can there be 1% of  $n=50$ ? If one specimen calcified, it would be at least 2%. For *B. marginata*, about 2.5 specimens per treatment calcified under anoxia:

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2.3-3.3 cm, total seeded population = 31 or 32; 8% (+/- 4%) calcified = 1-4 specimens. Not impressive numbers.

Were the foraminifera labeled with calcein in an aerated habitat? Were they allowed to acclimatize prior to placement in the hypoxic or anoxic core sections? The authors are urged to explain how acclimatization, or lack of acclimatization, impacts their results.

It is reassuring that the authors included the significant caveat on the issue of the sediment homogenization near the end of the manuscript. But, in addition to this issue, there is the issue that the segmented cores used for the foraminifera experiments may not exclude oxygen as the authors assert. The presented geochemical profiles were obtained from unsegmented cores, not those that housed the foraminifera. Additionally, the presence of foraminifera could have affected the geochemistry of the sediments. Thus, the geochemical profiles are basically worthless and serve no point of comparison. Therefore the results are tenuous at best.

For the *A. tepida* experiment, what is meant by “filled with N<sub>2</sub>-flushed ASW”? The text notes that the subsurface intervals were loaded with 50 *A. tepida* and then filled with seawater. These are supposed to be down core samples. If seawater was added, then each interval was by definition, a sediment/water interface. This along with the possibility of non-air-tight cores throws significant doubt on the results about calcification or even survival under anoxia.

The basis for the statement “that during short anoxic periods, foraminifera will continue to calcify, at least at the sediment-water interface” is not clear. What short interval? 60 days is a short interval?

What is the basis for saying in the first sentence that “oxygen depletion is one of the most severe environmental stressors in marine ecosystems”? There is an entire ecosystem that exists in oxygen depleted marine habitats; these organisms are not stressed by such conditions.

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The statement that fossilizing calcareous tests of foraminifera “register the geochemistry of seawater” is a major overstatement. In some cases we think they register the seawater in which the foraminifer grew, but in some cases they do not. Please be sure to be accurate in assertions.

Using the word “proved” in scientific literature is an unwise choice.

The statement about “recent discovery of facultative anaerobic metabolism” in foraminifera and citing one paper from 2006 is misleading. There are a number of earlier publications that showed facultative anaerobic survival of foraminifera. The authors are urged to cite these papers.

How was sediment sieved over such a fine screen without added liquid? Did the authors use a 38 micron screen? The text notes a <38 micron sieve.

How do the authors know that the FDA signal they see is foraminiferal and not bacterial?

France is not in the West Atlantic, per the statement in Section 2.2.

How did the authors minimize evaporation during the 60 day experiment?

How might the lack of feeding during the experiment impact the results?

The entire section on pH profiles is poorly written, awkward, and undecipherable.

Why are “nitrates” plural?

The authors are reminded that anoxia by definition is a lack of oxygen, thus “completely anoxic” is poor word choice.

The sentence on page 4677 lines 7-9 belongs in the Discussion, it is not a Result.

The authors are urged to not make overstatements such as “severely adverse conditions” and “highly adverse”. Again, that is judgment from an anthropocentric perspective.

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It must be made clear that the papers cited in the first sentence of section 4.3 are examples and not an exhaustive list. Thus, “e.g.,” must be included for both of these sets of citations.

The inference about juveniles being more susceptible to anoxia is pure conjecture. Please include citations of other studies that show this for other taxa. There are no life stages in foraminifera (no molt stages, no larvae).

It is not “generally assumed that no foraminiferal tests are produced during anoxic periods”. What about the pore-size proxy with respect to oxygen concentration (Kuhnt et al. 2013 DSRI; 2014 JFR)? What about elemental ratios (e.g., Mn/Ca; Groenveld & Filipsson 2013 BG)?

The title is not particularly accurate of the content, given much of the manuscript reports survival rates.

The awkward English phrasing, incorrect spelling, inconsistent spelling and poor grammar must be corrected. For example: “The samples were kept refrigerated until laboratory.” What does this mean? Or: “This aspect will be further discussed in the next paragraph”. The next paragraph noted nothing about the topic.

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Interactive comment on Biogeosciences Discuss., 11, 4669, 2014.

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