

Interactive comment on “Copper incorporation in foraminiferal calcite: results from culturing experiments” by L. J. de Nooijer et al.

Anonymous Referee #1

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Since vigorous environmental disturbances have been taken place on Earth due to modern anthropogenic activities, environmental analyses both present and past are important approaches for giving evaluation and assessment against on-going environmental changes. Foraminifers are sensitive proxy organisms for monitoring marine environmental changes, in particular to coastal and shallow seas adjacent to human activities. Traditionally, empirical methods such as distribution of species, abundances and test deformations at specific environmental settings have been used for evaluating environmental disturbances. Recently, geochemical signals such as concentration of trace elements or stable isotopes within calcareous test are commonly used for environmental proxies. However, we should evaluate how biological and chemical signals are reliable to use as proxies for specific environments. Culture experiments under

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well-controlled environmental conditions should be effective methods for evaluating present environmental proxies and also for proposing new proxies. However, not so many works have been made to evaluate environmental proxies through culture studies. Most scientists tend to avoid culture experiments mainly because culture studies are just time-consuming and risky works. In this context, I congratulate that the authors challenged to make culture experiments with hand-made systems. I really enjoyed to read this manuscript.

In total, this manuscript is well-written and should be published on the journal “Biogeosciences” with minor revision. As I have emphasized in general paragraph, culture studies should be encouraged to progress by many scientists who are working on paleoenvironmental researches.

Several questions and comments are given in below.

1. How did the authors evaluate that culture conditions are similar to natural conditions? Culture environments are not the same as natural environments, so that we should evaluate how the environments are different from or similar to the nature as far as possible.
2. Did the authors control or monitor dissolved oxygen concentrations in seawater during the course of culture study? *Ammonia tepida* is free-living species that is dwelled within sediments. This means that *A. tepida* individuals sometimes dwell in oxygen-depleted condition below oxygen penetration depth and construct new chambers at the level. Copper should show different behaviors under oxygen-depleted environments.
3. Many of authors believed that test deformations were commonly taken place under stressed environmental settings. However, this is different from genus to genus. Both miliolid and discorbinid species are the groups that test malformation are easy to take place, as Arnold (1954) already described. *Ammonia* species are also easy to deform. However, glabratellid and some other rotaliid show little malformation under stressed environments. We should consider these facts when we discuss test deformation dur-

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ing cultures.

4. Very biased partition coefficient values, between 0.1 and 0.4, were obtained through the research. How do you evaluate these values? How about microenvironments around tests? How do you evaluate kinetic effects during biomineralization?

5. Minor comments: One paper is missing to refer. Marechal-Abram, N., J.-P. Debeney, H. Kitazato and H. Wada, 2004. Cadmium partition coefficients of cultured benthic foraminifer *Ammonia beccarii*. *Geochem. Jour.*, v. 38, no. 3, 271-283.

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