

## ***Interactive comment on “Marine bivalve geochemistry and shell ultrastructure from modern low pH environments” by S. Hahn et al.***

**Anonymous Referee #2**

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General comments: The MS by Hahn et al. uses a multi-technique approach to investigate the relationships between pH and bivalve geochemistry (with possible application of bivalves as palaeo-pH proxies). While impressive attempts were made by the authors to account for mussel transplantation to a new site as part of the experimental procedure, as discussed by the authors themselves, that process appears to prevent the MS from conclusively determining relationships between pH and geochemistry. At present, the MS is therefore a good description of shock responses by mussels in the natural environment rather than the basis for using mussels as pH-palaeoproxies.

Specific comments: 2.1. Field study. The sudden movement of the mussels to a new, low-pH, environment without an acclimation period to a gradually reduced pH suggests that this study is investigating shock responses to environmental change.

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This is acknowledged by the authors themselves and they suggest it as a problem in the experimental design to explain the absence of conclusive results. I suggest the authors re-focus the MS, and their hypotheses, to investigate mussel shock responses rather than providing baseline data for the use of mussels as proxies. Similarly, the 68 day experiment lends itself well to determining shock responses rather than adaptation to longer-term changes in pH. That said, by including more data on the transplanted control mussels (see below) the authors may still be able to glean some geochemical-proxy type information assuming the transplantation control mussels show little, or no, response to the transplantation itself.

2.2 Materials: this section would be better suited to the introduction.

2.5 Sea water carbonate chemistry: a new section 2.5 should be added which describes how the sea water carbonate chemistry was determined in detail. Questions include: was CO<sub>2</sub>sys used, were nitrate and phosphate measured, were alkalinity and pH the only variables used to calculate DIC etc.

3.1 Macroscopic observations: Include the image of a mussel from the control transplantation to make all the comparisons easier to visualise. Including the *Mytilus edulis* as a reference double control is a nice addition, but it would be preferential for the authors to use *M. galloprovincialis* from the collection site. If such a mussel is available this should be used instead of the *M. edulis*. If not, I suggest removing all the *M. edulis* data as they are confusing to the reader (I had to think for quite a while as to why it was included). This will make the MS much easier to follow.

3.1 lines 20-25: this is an interesting bit! This should be presented as a graph with error bars and a schematic of the mussel for navigation.

3.1 EBSD: Both in the text and the Figures 4 and 5 the authors should also include the same data collected for the control transplanted mussel as comparison. This will allow the reader to determine the relative impacts of transplantation and pH on the changes in structure.

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3.1 EBSD line 18: I would not say the pole figure shows “unordered” c-axis orientation but rather “less ordered” that prior to transplantation. Again pole figure of the control mussel should be included. I suggest point rather than contoured pole figures are used; contoured pole figures use interpolated data. The authors could include maps and pole figures before transplantation, directly after transplantation and at the end of the experiment to provide orientation data on shock vs adaptation by the mussels. In Figures 4 and 5 you should include a colour coded orientation key to aid the reader in determining which axis is represented by each colour.

3.3.1 Elemental abundances: The authors should show similar maps for the control transplanted mussel. Regarding figure 6, I appreciate that the maps probably need to be of different dimensions as the shell gets thinner, however, it leaves open the possibility that patterns observed in map 2 could represent a section of the patterns observed in map 4 as the size and magnification of the maps differs. To be certain that the patterns differ in reality, the maps should be presented at the same magnification and if possible the same dimensions. I don't think figure 7 is necessary; the space would be better taken up with a figure showing the control transplanted mussel data equivalent to figure 6 as described above.

3.3.2 Isotopes. This is interesting, but confusing to follow. I suggest that only data on the calcite layer are presented in this section.

3.3.3. Isotope time series: A large portion of these results could be placed in a table making them easier to interpret. There is a lot of information here so a table will help the reader digest the data. Figure 8: I think this plot could go in the supplementary material as it does not directly give information pre / post translocation. Also, the dashed vertical lines should be in all or none of the plots and the font size needs to be increased.

4.1 Mytilus: this section would be better suited to the introduction as well as the first part of section 4.2

4.2 page 10365 line 17. Avoid using the word “obviously” in scientific writing; nothing

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is obvious to a non specialist reader.

4.2 page 10366 line 6: I think this would be better phrased as “more unstructured than the control”.

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Interactive comment on Biogeosciences Discuss., 8, 10351, 2011.

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