Biogeosciences Discussions

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Reply on RC1

Daniel François et al.

Author comment on "Acidification impacts and acclimation potential of Caribbean benthic foraminifera assemblages in naturally discharging low-pH water" by Daniel François et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2022-91-AC1, 2022

Dear Sven Uthicke,

Please find our response to your very insightful comments, which improved the manuscript considerably. Below we address each comment (following each comment).

Referee #1 Major comments:

Comment - The MS submitted Francois et al presents a field study of the effects of ocean Acidification on (sub?) tropical benthic foraminifera communities, using a unique ecosystem in Mexico as environmental proxy for high pCO2. The study finds several trends in community and species shifts of previous studies confirmed, but also detected some trends opposite to those. In general, MS is well-written and analysed. However, I have several comments (listed below) which I believe should be addressed prior to publication.

My main issue is that the MS needs to discuss and investigate in more detail if other factors then pH can be the cause of community shifts or species stress. The possibility that salinity (very highly correlated with pH) may play a role is dismissed with a citation (in the results, this should be in the discussion). I think this should (and can) be further tested. For example, the linear models showing species changes along a pH axis could also be run with salinity, and with salinity and pH in the same model. Models could then be compared with AIC. Other potential influences of 'unmeasured' parameters (e.g. heavy metals) should be discussed.

Reply: We thank the referee for this very helpful comment. As suggested we ran the models and compared their quality using the Akaike information criterion in R. The temperature and salinity were the models with lowest fit, even when together with pH, corroborating with the results of the BIO-ENV and global BEST test. Interestingly, we found that Alkalinity presented the best fit with foraminifera abundance, which agreed with our hypothesis that the higher T_A would reduce dissolution rates and explain why calcifying forams would still occur at low-pH conditions (e.g., 7.1). The models with best fit (i.e., pH for the metrics H',J',S and T_A for N) were plotted in fig. 5.

Regarding heavy metals – the concentrations of the metals we analyzed (Paytan unpublished) were not significantly higher at the discharge sites when compared to the control sites. We do not have a lot of heavy metal data because it is a lot of work and when we found that the concentrations at the springs were not high, we did not analyze

anymore. Thus, we decided to not include this information, but we could add a sentence along the lines – preliminary data for heavy metal concentrations did not show significant differences between ojo and control sites hence we do not attribute the changes in foraminifera calcification observed to impacts of heavy metals.

Comment - It would be good to shorten the MS, and possibly omit some sections. In fact, with some extra effort this may even constitute 2 publications. At the present state, e.g., I find the microscopy a little unconvincing, with only 4 samples from each location statistics has little power to find differences.

Reply: We have shortened some sections and excluded the SIMPER/Cluster and CCA analysis from the manuscript.

Regarding the statistics, the Kruskal-Wallis test was performed considering the entire pH gradient (regardless of the site), i.e., 26 samples for each statistical test.

Comment - At some places the literature does not capture all relevant studies. I think all vent studies are captured, but several experimental studies (on pCO2 effects, but also e.g. on the mentioned nutrient effects) are omitted.

Reply: We have re-analyzed the literature used and now added some relevant experimental studies to the manuscript. However, it is impossible to refer to all experimental studies as they are numerous.

Minor comments

Comments

Abstract, ln 22: shift bracket not to imply 7.1 is the end of century prediction

Introduction, Ln 30: 'to' missing in sentence?

ln 46: 'became' = 'becomes'?

ln 75 (an in other places: post mortem (2 words?)

Reply: We thank the referee for noticing these mistakes. We changed them accordantly.

Comment - throughout: pH scale needs to be specified (I assume 'seawater' or 'total'?)

Reply: We used seawater and it is now specified in the manuscript.

Comment - ln 128: if only 'total' foraminifera are used as a metric, it seems redundant to describe the staining process?

Reply: The description of the staining process was removed.

Comments

Ln 170: what are the groups the stats is conducted on for, define first

Several analyses (linear models, correlations?) are not mentioned in the stats section. Mention details of analysis (including N, error structure, random factors?) here.

Reply: These information are now included to the stats section.

Comment - Ln 237: I think you cannot call the first axis a 'gradient of acidification stress". It is a composite of several factors (including salinity)

Reply: We removed this analysis from the manuscript.

Comment - Fig, 4,5,6: simplify and make more usual graph style. There is no need to have axis labels on all 4 sides, some labels in composite graphs can be removed.

Reply: We thank the referee for the suggestions and the figures were changed accordantly.

Comment - Fig 6 (and respective text): is this adding much, or one of those sections which could be omitted/or in another MS?

Reply: As explained above the simper analysis was removed from the manuscript.

Comment - Fig 7: also a very nice and interesting analysis, but, again, could be part of a separate MS?

Reply: As the community size was important for the taphonomic analysis, we decided to keep the analysis in this manuscript. That is because *Archaias angulatus* was responsible for both increasing pattens of dissolution and assemblage size due its higher preservation potential.

Comments

Discussion, ln 399 several experimental studies on the effect of LBF on nutrients exist.

ln 420: Kuehl et al: also a study by M. Glas. Also consider a study by S. Doo showing that LBF under OA are better off having photosynthesis or living on plants.

Reply: We thank the referee for the suggestions and the following studies are now cited in the manuscript:

Vogel and Uthicke, 2012, DOI: 10.1016/j.jembe.2012.05.008

McIntyre-Wressnig et al., 2012. DOI: 10.3354/meps09918

Schmidt, Kucera, and Uthicke, 2014, DOI: 10.1007/s00338-014-1151-4

Fabricius et al., 2011, DOI: 10.1038/NCLIMATE1122

Uthicke and Fabricius, 2012. DOI: 10.1111/j.1365-2486.2012.02715.x

Glas et al., 2012, DOI:10.1371/journal.pone.0050010

Doo et al., 2020, DOI : 10.1002/ece3.6552