Biogeosciences Discussions

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Comment on bg-2022-91

Anonymous Referee #2

Referee comment on "Acidification impacts and acclimation potential of foraminifera" by Daniel François et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2022-91-RC2, 2022

The paper by Francois et al. reports natural experiments of ocean acidification to understand the impact of Caribbean benthic foraminiferal assemblages near low-pH water discharging spring sites. Since this kind of natural experiments is still rare in foram research, the results are valuable and well-presented using univariate and multivariate analyses. However, I found a major issue for the authors to reconsider prior to publishing this paper.

The main issue is what time scales the authors are discussing. If the authors focus on decadal time scales occurring in this century, the conclusion in this paper is mostly incorrect.

This is because the paper deals with total (live and dead) foram assemblages in sediment and the proportion of live tests identified as stained tests is very low (3%) in the assemblages. That means that 97% of dead foram assemblages are results from long-term accumulations and taphonomic processes from various sources of habitats. Some may be in situ near sample sites, while others are transported or bioturbated particularly in shallow-water setting (the authors should show the bottom current speed and rates, as well as any benthic organisms inducing bioturbation). Some may be pristine, while others are very old (the authors may be surprised if the authors measure the radiocarbon age of foram tests). Table S3 shows that most tests are dissolved and/or broken. This means that dead tests are not pristine and are transported/bioturbated. Nevertheless, this paper discusses the effect of low-pH water gradient occurring in the present time as if all foram tests are in situ and very recent products.

If the authors like to discuss OA impacts on foram assemblages occurring in this century, the authors should have sampled phytal and rubble substrates and studied only live assemblages. Even if the authors consider the foram tests are mostly in situ and recent

products, the authors should at least show all foram taxa were found as stained tests at the sample sites.

I rather think the results are more applicable to geological OA record if the seawater chemistry of past OA records is similar to those in this study. I suggest that the authors reconsider whether your results are really able to discuss the OA impact occurring by the end of this century on living forams.

This paper also does not discuss the possibility of dissolution of carbonate sediments including foram tests during daily pH variations (particularly during night). See the following BG paper.

https://bg.copernicus.org/articles/9/1441/2012/

Minor comments including technical corrections are as follows:

Title: be more specific (e.g. … of Caribbean benthic foraminifera to naturally discharging low-pH water)

L42-44: this is mainly due to planktonic forams in the outer ocean.

Table 1: add the distance from the center of spring/fracture sites, spring water flow speed and rate, and sediment grain-size distribution.

L97: sediment grain-size distribution data are necessary to confirm if grain size does not affect foram assemblage compositions.

L97-98: explain in more detail; how far from the center for each site?

L128-130: the authors should have sampled macroalge and rubble.

L132: 1 ml? Is unit correct? 1 gram of sediment?

L212: Table S1 is not found in the supplementary data.

L243: Thoculina>Trochulina in Fig. 2?

Fig. 3: species name should be better to express as lower-case letter to avoid confusion with environmental variables (TA vs. AT). Two ACs are found. AL>AG?

L262: Fig. 5c>4c. Check all fig numbers in this paragraph.

L263: Fig. 4a>4e

L268: H?

L276: Fig. 4e>4b

Fig. 4: This graph shows that SB & Agg dead tests are resistant to dissolution, remaining in sediment compared with smaller forams (SM, SR, OP). This is results of dead tests, not meaning that live forams can survive in low pH environments.

L286: ind/ml, unit correct?

Fig. 5: foram abundance decreased due to dissolution?

L319: table S3>S2?

Fig. 6: legends are hard to understand. What's 3% mean? Why not listed alphabetically?

Why is Similarity not listed from low to high? What does y-axis variation mean?

L334-336: higher resistance to dissolution by low pH and breakage by sediment transport and bioerosion.

L339: P-value of 0.00 is not correct expression.

Fig. 7: a) the authors should confirm if results are not affected by spring flow speed. c) the unit of assemblage test size as %? dashed lines in caption?

L371: table S5>S4

Fig. 8: Charrieau et al. (2022) in Sci. Rep. reports shell dissolution in living Peneroplis, the same large symbiotic miliolid forams as Archaias. They also show no significant difference in calcite density of living tests between different pH conditions. Even if the authors used pristine tests, the authors cannot tell if the calcite density changed either during living stage or post-mortem stage.

L381-382: may be correct for dead tests, but not for living tests.

L387-388: only for dissolution resistant taxa (SB)

L389: but not living ones

L440: table S3>S2

L447-448: maybe due to post-mortem dissolution.

L453: the authors cannot tell from your results.

L460: relatively higher resistance of post-mortem shell dissolution to low-pH

L468: this is what you found in your study.

L725 and others: check the journal name abbreviations.