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Biogeosciences Discussions

Interactive comment on "Impact of carbonate saturation on large Caribbean benthic foraminifera assemblages" *by* Ana Martinez et al.

Anonymous Referee #2

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The paper by Martinez et al. describes a very interesting study in which natural variability in carbonate saturation state at submarine springs (ojos) is used to assess the benthic foraminiferal response to ocean acidification. The authors find that proximity to submarine springs impacts the benthic foraminiferal community. In particular, they find a decrease in overall abundances, but also that symbiotic calcareous species are less affected than non-symbiont bearing species, and agglutinated foraminifera may be least impacted. The paper is overall well written, and the conclusions are interesting. However, in some areas, the complexities and richness of the underlying dataset could be better served. Digging further into some of the complexities here should allow the authors to better support their current conclusions, but I suspect it will also lead to some more specific and novel results. Overall, there are three major (somewhat

related) issues, which I would strongly urge the authors to address.

1) First, is the assumption that proximity to "ojos" impacts benthic foraminifera entirely or primarily due to difference in calcite saturation state from the ambient environment. This does not seem like a foregone conclusion to me. These are essentially isolated regions of increased fresh-water influence in a marine context and could be different in a number of ways from the surrounding environment. The authors mention, but then rapidly dismiss, the salinity differences between the ojos and ambient environment (6:24-28). However to entirely dismiss salinity requires either a more detailed quantitative analysis to try to tease apart these covarying parameters, and/or a more in depth discussion of the known sensitivities of different foraminifera and communities to salinity. There could be several additional environmental differences, such as oxygenation, or changes in nutrient or metal concentrations from terrestrial sources that could produce sensitivities in some species (I might look into the literature on benthic foraminifera communities as tracers of metal contamination). Finally, there could be differences in benthic community or environment (substrate? Food source? predation?) between the ojos and control sites. All of this should be discussed. 2) A broad view of how major groups of foraminifera respond within the community (symbiotic, agglutinated, etc.) is much needed and well served by the study design. However, it is a shame that it comes at the expense of a discussion of a species, clade, or more finely-defined functional group level response. This study would be more impactful if it also reported the species-level assemblages at each sites. Are there specific species or genera that appear more or less robust to the environmental differences between ojo and "control" environments? Such a discussion is especially warranted given the species-level differences in response to ocean acidification that have repeatedly been shown in culture studies. 3) Finally, there appear to be clear differences between ojo/control pairings which are occasionally mentioned in passing, but never fully addressed. For example, looking at Figure 2, I am immediately greeted with some pretty basic questions such as "Why is there such a large difference in abundance at Mini and its control compared to Gorgos and its control?" and "What is different about Norte that

the low-saturation abundance is as high as the high-saturation groups at other sites?" If saturation state is the primary driver of total abundance this should be an unexpected result! Without further information or context about either the assemblages or environments at each site, it is hard to even start thinking about some of these complexities. There is a lot to uncover here that may still require some further analyses.

Minor points: - Why the use of the >255 size fraction? Could this have biased the results especially is different size species respond differently? For example the Henehan et al., 2017 paper on weight suggests size may impact species calcification response. Is it possible that smaller species may have differing metabolic requirements? - What was the depth of each site? I almost wonder if this could be contributing to some of the inter-site differences? - Can you report all species identified (in addition to the most abundant)? It would be very valuable for assessing assemblages at a finer scale and also for future workers. Ideally, it would be good to see full assemblages reported at each site and represented and compared in a figure. - How large were the sediment samples from which forams were measured? Did it differ between sites? And how were they collected? Importantly, how deep into the sediment were samples taken and was consistency in this regard maintained across sites? - Page 2, Line 12-3: It is also worth noting that some species also tolerate (even specialize in) high CO2 environments such as oxygen minimum zones – look into some of the Bernhard papers on this in Santa Barbara Basin– and low salinity (low saturation state) estuaries. - Page 3, Line 12: What is your balance error? - Sections 3.3. and 3.4 raise a lot of questions for the reader about what is producing the reported differences between sites. See major point 3, but I think the conclusions could be made sounder if some of these type of questions are tackled. - Section 3.5: Again, it looks as if there may be a difference between sites. Is this statistically significant? Also, this should refer to Figure 4. - Page 5L Line 1: "but not Gorgos" - Page 6, Lines 23-34: "Therefore, while abundant CT may help lower the potential impact on foraminiferal calcification at low pH, it does not seem to fully counteract the effect of low Ω ." I don't think this is quite right. If I understand correctly, the authors are arguing that this important parameter is carbon-

ate ion concentration/saturation state, and total inorganic carbon and pH are important drivers of this both intra- and extra-cellularly. If so, this should read along the lines of "Therefore, while abundant CT may increase the availability of carbonate ion, it does not seem to fully counteract the effect of low pH on Ω." - Page 7, lines 1-3: This really glosses over the huge history and literature on shell weight and carbonate chemistry in planktonic foraminifera. Have a look at Table 7 in Weinkauf et al., 2016 for a good (though not exhaustive) review of some of this work. - Page 7, lines 8-10: Davis et al., 2017 also shows variable individual responses to saturation state within a population of foraminifera. - Many of the figures appear low quality and pixelated. This may be the result of embedding, but double check. Also, why not include color as well as gray-scale for this online pupblication? - For figures 2-4, it would be useful to have represented on these plots which groups are significantly different from one another (as in the Results section). Consider including this?

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