Response to Referee Comment 2

AC: We thank Referee 2 for their helpful comments and suggestions to improve the manuscript. We have addressed each major comment below. We will incorporate all "notes for specific parts" listed by Referee 2 unless a comment is made below.

RC2: This manuscript entitled "Southern California margin benthic foraminiferal assemblages across a modern environmental gradient record recent centennial-scale changes in oxygen minimum zone" by Palmer et al. presents a valuable dataset from a gradient of one of the most prominent OMZs in the world. It presents the calcareous benthic foraminiferal assemblages focusing in size fractions from core tops along a depth transect. Later the authors investigate these assemblages in short cores in order to investigate the recent history of the OMZ and the benthic foraminiferal assemblages. The information provided here is an important input for the ongoing investigations regarding the relationship between OMZs, ecosystem and climate. Overall, I found some major details missing in this study and I believe it can be improved significantly.

1. This study is based on benthic foraminifera taxonomy work which should include references to species nomenclature also preferably a plate showing the major species mentioned. In case it is not possible to provide figures, there should be a section where list of species observed is given with references used for identification. For example: Bolivina spissa = Bolivina subadvaena Cushman var. spissa Cushman 1926a. [Figures 10.7, 11.4]. This is essential for taxonomy based papers where the reader will be able to evaluate the information provided. The number of publications without any reference material is increasing and this leads the misinterpretations regarding the foraminifera research. The authors mentions their concerns in the discussion therefor I highly encourage this MS to have section dedicated to nomenclature.

AC: We will update the list of species observed with the references used for identification. We will also add a plate with images of the 6 species that are discussed in depth in the paper.

RC2: 2. Introduction and discussion should be improved in terms of using literature and previous work from different OMZs. For instance there are significant amount of work from the Peruvian and Arabian OMZs focusing on similar oxygen gradient and benthic foraminiferal assemblages. These studies should be included in terms of benthic foraminifera habitat in relation with oxygen and nitrate availability etc. This will improve the MS significantly. It is a pity that the species are not stained limiting the comparison with previous studies, and yet I believe the information presented here is really valuable.

AC: We will improve our literature review and include more literature from OMZs outside of the North Pacific (Erdem et al 2019, Caulle et al 2014, Enge et al 2016, Mallon et al 2011, Mazumder et al 2014). Further, per the comments of referee 1, we will incorporate a more thorough literature review on the distribution of foraminifera in low oxygen/high carbon environments and of foraminiferal test size in relation to oxygen.

AC: The environmental parameters listed are from measurements of bottom water conditions taken at the same time as sediment core sampling.

AC: We will incorporate an introduction to nomenclature in the introduction that will make the entire paper more readable and streamlined. We received similar comments from referee #1 and we will address them both.

Notes for specific parts:

AC: We will add the suggested reference to this section of the paper.

AC: Based upon this suggestion and that of Reviewer 1, additional observations from OMZs will be added.

AC: We will incorporate the suggested change.

AC: We chose to use a dbRDA instead of a CCA because drRDA allows for the use of Bray-Curtis dissimilarity rather than Euclidean distance in quantifying differences between groups and is able to integrate data from drivers (environmental factors) as well as assemblages.

AC: We will incorporate the suggested change.

section 3.1.: this section is confusing. please be clear with what is presented here. I assume these are the deepest points CTD measured? is there any pore water measurements or are these only water column? and salinity should be included as well in the table.

AC: The data shown here are the deepest CTD points measured, not pore water measurements. We will add salinity to the table.

Line 205: is ANOVA introduced already in methods?

AC: ANOVA was not introduced in the methods. We will add ANOVA to section 2.3 on foraminifera assemblages.

line 222: the term edge dominant.. what does this actually mean? According to which previous work edge of the OMZ is considered?

AC: Incorporating the referee's earlier comment about adding some clarifying language and nomenclature to the introduction would be helpful here as well. In this case, we are referring to a species (*B. argentea*) that is most abundant at 528m water depth, near the upper margin of the modern OMZ. A previous study that we cite in the paper, Mullins et al 1985, also finds a high abundance of some species of benthic foraminifera at similar depths and attributes this to the higher concentrations of biologically available nitrate and nitrifying bacteria at the edges of the OMZ as compared to the center. We will cite this paper here to show support.

line 224: sentence starting with "in some taxa,.." needs rephrasing. paragraph starting from line 268: this could be written much simpler, I am not sure I understand the information provided here.

AC: We will improve these lines for clarity and simplicity.

page 9 first paragraph: we know today oxygen limited high organic matter input regions are characterised by high population low diversity of benthic foraminifera. it is interesting to see this is not the case at these sites. Nevertheless, I am not fully convinced the evidence provided in this study is enough to come to this conclusion. What do the authors think, if stained species were considered only the results would show any difference or not?

AC: The referee poses an important question here. Unfortunately, there are not many studies in this region comparing live/dead assemblages so it is difficult to speculate on this point. Further, some studies (Bernhard et al 2006) have shown that Rose-Bengal staining does not accurately capture the live foraminiferal fauna. Other studies that have examined stained vs. unstained including Jorissen and Wittling 1999 document that some epifaunal and superficial infaunal species may reproduce opportunistically and thus have higher seasonal variability in comparison to infaunal species which they document as having stable densities through time. Thus, the assemblage we quantified may oversample epifaunal taxa relative to infaunal taxa in comparison to what may have been found if the samples were stained.

Line 301: what does "...size fraction or 2" mean? paragraph starting at line 312: for such a discussion based on specific species, authors should provide a reference list including species names as mentioned earlier.

AC: We will add a species list and reference list for the species that we discuss in detail. "Size fraction or 2)" was part of a larger list, we will remove the 1) and 2) for clarity.

line 341: this is the first time specific oxygen concentration and terminology is given. This should come earlier.

AC: This will appear earlier, starting in the introduction.

paragraph starting at line 365: discussion on Bolivinids: there are so many studies on bolivinids at similar setups, those should be mentioned and discussed here. Some examples are: Mallon et al., 2012; Cardich et al., (several papers), Glock et al., (several papers), Caulle et al., 2014; Jannink et al., 1998. the list goes on.

AC: We will add these references.

line 387: Please rephrase the last sentence.

AC: We will incorporate the suggested change.

paragraph starting with line 424: it would be nice to compare results with previous observations from the region.

AC: We will incorporate the suggested change.

comment on data availability: will it be open access upon publication?

AC: Yes, the data are already available and open access on NOAA Paleoclimate Database.

Figure 1: please give more information in the figure caption including which sites have what kind of results in the text. what are the depths of these sites?

AC: We will incorporate the suggested change. The depths are 300, 528, 700, 800, and 1200 m, this can be added to Figure 1.

Figure 2: water depth on y axis? station names could be implemented.

AC: Water depth is on the y axis in this plot. We will clarify this in the figure.

Figure 3 caption: "General observations .... " this is not needed here. Figure should be cited in the text more often.

AC: We will cite Figure 3 in the text to improve clarification. Referee #1 also suggested the same change. Further, we have updated Figure 3, this will add clarification to this point.

Figure 4: y axis please mention Rel. Abundance (%) instead.

AC: We will incorporate the suggested change.

Table 1: please add salinity and the captions should be more informative including where this information comes from. CTD? porewater? what is TOM?

AC: We will incorporate the suggested change. This data comes from a CTD (as answered above) of bottom water, not porewater. TOM is total organic matter, methods for this are listed in the methods section of the paper.

Table 2 caption: mixed planktonic foraminifera species. please remove bulk.

AC: We will incorporate the suggested change.