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Interactive comment on "Calcification intensity in planktonic Foraminifera reflects ambient conditions irrespective of environmental stress" *by* M. F. G. Weinkauf et al.

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We thank the anonymous referee #1 for their constructive comments, which touch some critical points of our paper. We believe that in the following we are able to address these issues. As a result, the revised manuscript will clarify some uncertainties, and include minor corrections.

We are responding to the issues raised by the referee one by one in the following. The repetition of the referee comment is in each case followed by our response to it.

1. In the Abstract, it is stated that Marshall et al. "could not exclude that ambient temperature played an important role in mediating" the observed relationship between shell

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area density and carbonate ion concentration. This is not correct. Rather, using multiple regression analyses, Marshall demonstrated that carbonate ion was the dominant variable controlling area density and that temperature (as well as phosphate) had no significant impact on area density.

The referee is correct in stating that Marshall et al. (2013) found the carbonate ion concentration in the sea water to be the most important influential factor for shell calcification in planktonic Foraminifera of the Cariaco Basin. However, in section 3.4, paragraph 17 of that paper it is stated, that "$\left[CO_3^{2-}\right]$ values were calculated for the upper 130 m at discrete depth intervals ... using A_T, pH, temperature, salinity, and nutrient concentration measurements taken during monthly hydrographic cruises...". Since the temperature was a parameter in the equation used to calculate the $\left[CO_3^{2-}\right]$, those two values are not independent, and consequently an interaction term involving both parameters cannot be ruled out by the statistical approaches Marshall et al. (2013) used in their study.

Furthermore, figure 4 presented in Marshall et al. (2013) shows indeed a significant relationship ($p < .001$) between shell calcification and temperature. Concerning that topic, the authors only argue that "the relationship between ρ_A and temperature ... could be due the colinearity of ρ_A with $\left[CO_3^{2-}\right]$" (section 4.4.1, paragraph 29). Neither the Multiple Linear Regression approach nor the Hierarchical Regression Model could rule out beyond doubt, that temperature, rather than $\left[CO_3^{2-}\right]$ or their interaction term, is the main influential factor for shell calcification. We will rewrite this part of the manuscript accordingly, to clarify that point.

2. Page 11216, Line 13 – define "optimal growth conditions".

We agree with the referee, that this term needs clarification. With optimal growth conditions we describe an environment in which the sum of all environmental factors is close to the optimum of the species, resulting in peak-values of productivity. This effect was exemplarily shown by Schmidt et al. (2004) on the example of water temperature.

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A similar description will be included in the revised version of the manuscript.

3. Van der Meer et al. (2007) is hardly the best reference for citing the planktonic foraminiferal oxygen isotope anomalies associated with sapropel formation. The paper by Williams et al., 1978, (Science) is perhaps the first study to link decreases in foraminiferal δ^{18}O with fresh water input during sapropel formation.

There is indeed wealth of earlier studies linking Mediterranean sapropels with isotopically-inferred freshwater discharge. We will refer to these in the revised version.

4. There is some confusion/misuse over the use of the term "measurement based weight" (MBW). Beer et al. present MBW data in units of μg, whereas Weinkauf use $\mu g/\mu m^2$. Clearly this latter unit is not a weight but rather is more similar to the area density measurement presented in Marshall et al. In fact, the equation used to determine MBW (equation 1) is not the equation given in Aldridge et al. for calculating MBW.

We agree with the referee, that our calculations are not providing a value for what has come to be known as MBW in the literature. Instead, we will adapt the term "area density" used in Marshall et al. (2013) and change the revised version of our manuscript accordingly.

5. Page 11233, Line 8: Barker and Elderfield did not study "modern foraminifera". Their study was based entirely on fossil assemblages.

In this case we were using the term "modern" for the material from the Pleistocene Barker and Elderfield (2002) were working with, to contrast it with deep time material. However, we agree with the referee that the term is misleading in this place, and we will delete it in the revised version of the manuscript.

6. It would significantly improve the paper if δ^{18}O data was included for O. universa, G. inflata and G. scitula. This would help identify depth habitat differences amongst the four species and show which species were being impacted by the low salinity water.

The isotopic habitats of these species have been studied in great detail by Rohling et

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al. (2004), based on material from the same sapropel interval as studied by us. We will make better use of this information when introducing the species habitat in the introduction and discussion sections.

7. I am skeptical that the small number of individuals per sample (usually less than 10; in the case of G. ruber the median sample size is only 4 shells!) is adequate to determine the MBW. Why not take some randomly distributed samples and weigh each individual shell for these four species. This would allow you to calculate some standard deviations on your mean values.

We understand the referee's concern about the small sample sizes, but we note that a solution virtually identical to that proposed by the referee has been already implemented in our study. The random resampling approach we used is described on page 11223, lines 5–23, and used throughout to estimate sample-size-dependent confidence intervals of the mean values we have calculated (which have also been plotted in Figure 3 and have been considered in the statistical analyses).

Interactive comment on Biogeosciences Discuss., 10, 11213, 2013.