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Interactive comment on "Reconciling single chamber Mg/Ca with whole test δ^{18}O in surface to deep dwelling planktonic foraminifera from the Mozambique Channel" *by* J. Steinhardt et al.

Anonymous Referee #3

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Review of the manuscript "Reconciling single chamber Mg/Ca with whole test d18O in surface to deep dwelling planktonic foraminifera from the Mozambique Channel" by J. Steinhardt, C. Cleroux, L. de Nooijer, G.-J. Brummer, R. Zahn, G. Ganssen, and G.-J. Reichart. This manuscript presents a large data set of single specimen stable isotopes and single chamber Mg/Ca on four species of planktonic foraminifera from a sediment trap in the Mozambique Channel which is affected by eddies. These lead to slightly different conditions in the water column affecting foram geochemistry. The authors argue that differences in the two sets, i.e. eddy and non-eddy conditions, show that combined stable isotopes and Mg/Ca can be used to reconstruct eddy conditions. Although the data set which is presented is large and very interesting, I'm not convinced

that the data show that eddies can be reconstructed with this. For me, the data show how large the variability in single specimen/chamber geochemistry is (which feels more like the main theme of the paper) and that eddy occurrence with different conditions leads to similarly large variations. The range in values for both settings is very large and therewith seems to exclude that it would be possible in a downcore study to make the distinction. The manuscript is generally well-written, but contains many small mistakes giving the feeling that it has been written in a hurry. See below for more detailed comments, but one example is the method section on Mg/Ca. This seems to be copied one to one from a previous paper, the cited papers are missing from the references, and a whole series of elements are mentioned which never show up in the rest of the manuscript. In summary, I recommend that this study is potentially very interesting and fitting in Biogeosciences, but still needs a lot of work. As such I recommend to return the manuscript to the authors with major revisions.

Major comments The first proxy in the Abstract mentioned is Mg/Ca, which also starts the methods, but then there are no new results showing up in the rest of the paper. Meanwhile it seems that all relevant information on the Mg/Ca is actually in a previous paper (Steinhardt et al., 2014). At the end of the ms d13C comes in, almost as a kind of afterthought. I suggest to make the paper more clear in what it really wants to tell the reader, to make it something which can stand on its own without needing other papers. The Mg/Ca measurements were done by Laser Ablation. Accordingly, test profile Mg/Ca will be representative of the migration of the foram through the water column. In the previous paper it was mentioned that this variability was not considered. Why is this source of information left out? The average of the profiles is taken as indicative for temperature, so the different parts should be too then and thus will give you temperatures of the different depths of calcification. Section 3.4: If parts are copied from previous papers then at least be precise and include the references into the new reference list. Several references (Reichart et al., Raitzsch et al., Jochum et al., Duenas-Bohorquez et al.) in the methods (3.4) are missing. Is it relevant for the paper that Na, Mn, Sr, Cd, Ba, and U have been measured? "695 values were obtained for 373 specimens".

Please explain, are these averages values for test profiles or single shots on the tests? If new data were measured for this study as written before, then show profiles how the data were generated. Results, Mg/Ca: This is very confusing! Are new data being presented or not? Ranges and temperatures are being mentioned; and differences in subsequent chambers of dutertrei, but no figures are showing these data. Going back to the Steinhardt et al., 2014 paper it is possible to find these data. But that would suggest that the current manuscript cannot stand on its own, it needs the reader to have the other paper along with it.

Minor comments Abstract: "i.g.": I assume you mean "i.e." with this? Page 4, line 7: Ortiz 5-22: Steinhardt et al., accepted? 7-14: "as previously described"; it is not very extensive to include this, it will be helpful. 7-17: how are eddy or non-eddy conditions separated? 7-23: the mooring is not present in fig.1 7-26: how significant is a meter-wise resolution? 8-15: ruber s.s. or ruber s.l.? 8-25-27: it is mentioned several times in the text that no size-related trends were present. Was this based on the few specimens mentioned here which were taken from a larger size fraction? In general, size-related effects in forams for isotopes and Mg/Ca are only found when including the more extreme size fractions, i.e. <250 or >400. Anything in-between does not show any trends. Section 3.4: see above. Line 5: "expanded", so extra profiles were lasered on the last chamber? These data should be shown. 10-16: delete "and"; lines 16-18: "are in good agreement". Be specific, give numbers. Page 11: it is unclear which dataset was used for d18Osw, from the global dataset or from the measured samples? Is this a new relationship for d18Osw and salinity? If not, include a reference. Why did you use the Kim and O'Neill equation and not the species-specific equations? 12-4: add brackets to 2014; which temperature calibrations were used to calculate temperatures? Do these data include the data from the previous paper too or just the new data? Intertest variability in ruber is highest. This is counter-intuitive if the species is the one which is migrating the least of all, sticking most of its life cycle close to the surface. How can this be explained? All the numbers in the Results section make it very confusing to read. Please add tables for this to give a much better overview. 14-11: "multi-specimen"? and

equation 4 should be 3 I guess. Discussion. 5.1: what is the message of the first paragraph? It is well-known that ruber is a shallow dwelling species. This can be shortened considerably. 15-23: Loncaric is spelled incorrect on several occasions. 16-3: remove brackets for 40-150. These ranges in reconstructed depths are the interesting thing in the paper instead of an average depth of 37 m. Apparently even under "stable" conditions you do already get such a large spread. Where does this come from?; "pooled specimen" in general this is not much more than 5 specimens, how representative are those measurements then for the population? 16-10: why not compare to your own dutertrei Mg/Ca? 16-15/22: includes a series of typos. 16-23: Mohtadi et al., 2009 is missing from the references. 17-6: this would fit it then with the Mg/Ca; how are the vital effects for the other species? Beginning 5.2: any geochemical signal recorded in a foram test is an average of the range over which calcification took place. So all reconstructed calcification depths are apparent. 18, middle paragraph: this belongs in the results and/or a table; last paragraph is confusing, please clarify. 19-6: "trends with test size", see comment before. Lines 6-20: what about the rest of the variability? And this would be the case for every species. The larger their depth range, the larger the variability would become. 19-26: which is which in this sentence? 20. first part: this uses the final chamber Mg/Ca or the overall Mg/Ca? These data should also go into a table. You can leave all these numbers out of the discussion then and just refer to the table. Model: how are the two constants determined? 23-14: "extended version". This is mentioned but not shown. The impact of secondary calcification is well-known and can take up the majority of the shell mass, not only in scitula but also in dutertrei and obliquiloculata. 24-9: remove the size trend part. 25-8: Why are all expected values higher than the measured ones? 26-11: How does the d13C indicate that Mg/Ca is a good indicator? Figures: No new Mg/Ca data are shown; it would be interesting to see how the data vary with temperature (and salinity) during the time the sediment trap was employed. Do the analysed data follow natural changes? Fig. 4b: why is this split up into different chambers? The exponential fit is not very convincing. The data may also be seen as constant values up to 20°C and a linear increase >20°C. Remove the

-2 from the Mg/Ca axis, that is not going to be a real value; Fig. 5: there seems to be more discrepancy between Mg/Ca and d18O than between eddy vs non-eddy; fig.6: remove typos from the caption; what are the non-grey boxes? Fig.7: there is no axis for the Mg/Ca values. The figure is way too small.

Interactive comment on Biogeosciences Discuss., 11, 17255, 2014.