

Interactive comment on “Variation in stable carbon and oxygen isotopes of individual benthic foraminifera: tracers for quantifying the vital effect” by T. Ishimura et al.

Anonymous Referee #1

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Dear editor,

I have carefully read manuscript bg-2012-204, entitled ‘Variation in stable carbon and oxygen isotopes of individual benthic foraminifera: tracers for quantifying the vital effect’ by Ishimura and co-workers and recommend it for publication in Biogeosciences. However, there are a number of issues that need to be addressed before acceptance, some of which may lead to substantial changes in the discussion and conclusions of this manuscript.

Major issues:

1. Part of the inter-individual variability in $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ that is reported (Table 2, C2247

Figure 3) may be caused by in-sediment variability in $\delta^{13}\text{C}_{\text{DIC}}$ and, to a lesser extent, the $\delta^{18}\text{O}$ of the pore water (Table 1). It may be that different individuals have calcified at different depths in the sediment and have thus utilized DIC with different carbon isotope signatures. More inter-individual variability in isotopic composition may thus reflect a wider range in depth habitats. This possibility should be discussed in the manuscript. Is there a relation between isotope composition and the sediment depth at which individuals from the same species were collected?

2. Variability in in-sediment depth habitat (within the sediment or water column) does not really count as a ‘vital effect’. Rather, it is a shift in environmental conditions that produces variability in isotope (or element) composition. Although habitat-effects are sometimes regarded as part of the vital effect, it is better reserved for the effects of metabolism, photosynthesis by symbionts, etc. The claim that the results presented here show the magnitude of the vital effect on carbon and oxygen isotopic composition is somewhat idle and is better avoided. Statements such as are made in the final part of the Conclusions need to be omitted. Also remove ‘vital effect’ from the title.

3. Section 3.2 suggests that the inter-individual variability in isotope composition can be used to reliably reconstruct $\delta^{13}\text{C}_{\text{DIC}}$ from foraminiferal samples ‘from throughout the world’. Such a generalization cannot be made on the basis of the dataset presented here. The foraminiferal calcite’s $\Delta\delta^{13}\text{C}$ and intra-species variability therein, may well be different for populations from other depths/ areas or with DIC that has a $\delta^{13}\text{C}$ outside the range found in the locations sampled here. Also adjust the Abstract accordingly.

Minor issues:

1. The living-dead divide is made based on staining specimens with rose Bengal. This method, however, does not allow accurate identification of living individuals (e.g. Bernhard, 1988, JFR 18: 143; Bernhard et al., 2006, Paleooceanography 21). This should be mentioned and references to ‘living’ foraminifera throughout the text should

be adjusted.

2. Section 3.3 invokes intracellular pH control as a source for inter-species (and perhaps also inter-individual) variability in calcitic carbon and oxygen isotopes. The inter-species variability in isotopes may be caused by the magnitude of pH control by different species (or by the inter-species variability in the pool of respired CO₂ that participates in calcification). Please add this to the discussion.

3. Language is sometimes ambiguous. E.g. Introduction, second page, line 5/6: the 'isotopic composition of biogenic carbonate' is not determined by 'ambient isotopes', but by the oxygen isotopic composition of seawater and carbon isotopic composition of dissolved inorganic carbon. Lines 10/11: 'microhabitats' are themselves not a 'cause of the vital effect', but rather, the vital effect may be caused by occupation of different microhabitats by different species/ individuals. Line 19: what are 'details of the isotopic variations'? Line 21/22: what does a 'clearer understanding' mean? Please check the whole manuscript for such phrasings.

4. Final paragraph of the Introduction should be removed.

5. Were the foraminifera cleaned before isotope analysis? Could the data be contaminated by oxygen and carbon isotopes from the organic material? What could be the contribution of this source compared to the calcite?

6. What is the saturation state of the bottom water/ pore waters with respect to calcite? Could there be any dissolution/ remineralization of the shells?

7. Please use the terms 'inter-species' and 'intra-species' (or 'inter-individual') throughout the text.

8. Does the dataset allow calculation of the number of individuals needed to accurately determine the ambient seawater $\delta^{18}\text{O}$ / $\delta^{13}\text{CDIC}$ for species that calcify close to isotopic equilibrium (e.g. *B. aculeata*; Table 3)?

9. I don't see the relevance of the water column $\delta^{18}\text{O}$ and $\delta^{13}\text{CDIC}$ in Table 1. Remove
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the '-' for the pore water temperatures. Statement at the end of Table 2 should be placed in the caption.

10. Apparently, not all specimens analyzed were 'living' (rose Bengal-stained; Table 2). Is there a difference in isotopic composition between stained and non-stained individuals?

11. It is very difficult to recognize the regression curves in Figure 4A. Differences between species are not (sufficiently) discussed in the manuscript. Is variability in morphology/ test thickness responsible for the different relations between weight and isotope composition?

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