

## ***Interactive comment on “Late Pleistocene Glacial–Interglacial related shell size isotope variability in planktonic foraminifera as a function of local hydrology” by B. Metcalfe et al.***

**Anonymous Referee #1**

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Title: Late Pleistocene Glacial-Interglacial related shell size isotope variability in planktonic foraminifera as a function of local hydrology

Author(s): B.M. Metcalfe et al. MS No.: bg-2014-579 MS Type: Research Article

Summary comments: The manuscript presents shell size isotope variability for three planktonic foraminiferal species covering the time period 200 to 250 kyr. Single shell isotope analysis ( $d_{18}O$  and  $d_{13}C$ ) was completed on *G. inflata*, *G. truncatulinoides* and *G. bulloides* from different narrow size fractions (e.g. 212-250 $\mu m$ , 250-300 $\mu m$ , 300-355 $\mu m$  and 355-400 $\mu m$ ). The results presented show that for *G. bulloides* there is no size isotope difference between size fractions for  $d_{18}O$ , whereas there are isotopic

C48

offsets for *G. inflata* and *G. truncatulinoides* across different size fractions. In regards to the shell size carbon ( $d_{13}C$ ) isotope variability for the different species and size fractions the authors note there is a general enrichment in  $^{13}C$  with size.

For *G. bulloides* where there is no size isotope ( $d_{18}O$ ) difference with shell size the authors show that the oxygen isotope values correlate with seasonal patterns of insolation and that the  $d_{18}O$  isotopic variability can be used for reconstruction of past seasonality changes.

The following is a page-by-page list of questions, comments and suggestions that should be considered.

Detailed comments:

Consider changing the title from “Late Pleistocene Glacial-Interglacial related shell size isotope variability in planktonic foraminifera as a function of local hydrology” to “Late Pleistocene Glacial-Interglacial shell size isotope variability in planktonic foraminifera”

Page 136, line 4; Consider changing ‘foraminifer shells hamper’ to ‘foraminifer shells that hamper’

Page 136, line 12; What do the authors mean by ‘dynamic size range’?

Page 136, line 13; Change ‘*G. inflata*’ to ‘*Globorotalia inflata*’ as this is the first time it is mentioned. Likewise, change ‘*G. truncatulinoides*’ (line 14) and *G. bulloides* (line 19).

Page 136, line 21-23. ‘Seasonal insolation patterns’ – What is the sedimentation rate of the core of interest? I am assuming it is relatively low to moderate and I would not expect to records/data to be able to resolve ‘seasonality’? I suppose the authors are attributing the overlap (or spread of  $d_{18}O$ ) for *G. bulloides*  $d_{18}O$  to represent forams tests that have live/grown in different seasons.

Page 137, line 12. The  $d_{18}O$  and  $d_{13}C$  of foraminiferal calcite is also a function of carbonate content (e.g. Spero et al., 1997), temperature (e.g. Bemis et al., 2000)

C49

and dissolution (e.g. Lohmann, 1995, Rosenthal et al. 2000). These impacts on foraminiferal d18O and d13C should also be mentioned in the text.

Page 137, line 17. Added to this is the complication is the shell-size dependency of isotopic offsets from dissolved carbonates (e.g. Kahn, 1979, Curry & Mathews 1981, Kahn & Williams 1981, Oppo & Fairbanks 1989, Oppo et al., 1990, Elderfield et al., 2002, Hillaire-Marcel et al., 2004.)

Page 137, line 24. Shell size – What about shell mass (e.g. shell weight)? How does shell mass affect isotopic values? I suppose shell mass may reflect a direct relationship of environmental stimuli in both growth/environmental conditions and/or post depositional conditions.

Page 138, line 4. 'hence large sizes' – Is there any correlation of these studies with shell size and mass?

Page 138, line 28. 'Subsequent investigations....single depth in core or core top,...' Studies like King and Howard 2004, 2005 examined the offsets in 'planktonic foraminiferal isotope values' and then looked at the isotopic values in sediment trap and sediment core tops etc.

Page 139, line 4. Consider changing 'We here test' to 'Here we test.'

Page 139, line 5. Expand 'TIII' to 'Termination III' as this is the first time it is mentioned.

Page 139, line 9. T90-9p location. Please include 'water depth' for the core location. I am assuming APNAP core T90-9p was collected well above the modern calcite saturation horizon? Hence, what about post depositional effects of foraminiferal stable isotopic composition over time at this site? Can these post depositional effects on foraminiferal isotopes be excluded from the isotope results presented here?

It would also be an idea to let readers know the 'sedimentation rate' at this site? Is this site a low, moderate, high sedimentation rate site where past seasonality climate signals can be resolved?

C50

Page 140, line 6. Change '(Termination III)' to '(TIII)'

Page 140, line 16. '2.1 Calculation of average size and weight'. This following section does not provide any information on 'weight' calculations. The text provides information on 'foraminiferal abundances (e.g. numbers per gram)'.

Page 140, line 20. 'into small aliquots approximately' – Did the authors 'split into small aliquots where 200 forams were collected/picked' or do they mean '~200 particles collected – including forams (all species), particles etc'?

Page 140, line 22-23. 'numbers per gram' – the numbers per gram was calculated per Peeters et al. 1999. Did the authors consider calculating the shell normalised weight (mass) for each of the foram species during this step to obtain an average weight?

Page 140, line 20-24. With the dried residual – did the authors consider further cleaning of the 200 foraminiferal species to remove any nanno fossil or carbonate particles contained within the foram tests prior to other analysis? E.g. for the stable isotopic measurements – the authors sonicated in ethanol to remove any foreign calcite/carbonate not from the foram tests for single foram isotope analysis.

Page 141, line 2. 'Bulk measurements routinely consist of between 8-40 specimens'. Were the bulk measures ultrasonically cleaned in methanol/ethanol?

Page 141, line 12. 'following ultrasonic cleaning in ethanol' – Ethanol? We typically use methanol for cleaning foram tests prior to analysis. I suppose each laboratory has a preference for a cleaning media during sonication just as long as there is no isotopic effect on the foraminiferal d18O and d13C during the cleaning process.

Page 144, line 8. 'Faunal abundance counts and size' – the methodology section has the subtitle 'Calculation of average size and weight'. In this section I assumed 'weight' was actually faunal abundance. Please clarify this in the text.

Page 144, line 9. I am assuming the percentage (%) values after each species is the abundance (in %)? From looking at the figures, there are large changes in the abun-

C51

dances for *G. bulloides* and *G. inflata*. I suppose these large difference or at least the time periods when these changes occur should be mentioned. Consider changing these first sentences to: "Over the time period of interest *G. truncatulinoides* abundance is generally <10% (Fig. 3). Faunal abundance for *G. inflata* ranges between ~10 to 40% with higher abundance corresponding with warmer interval MIS73 and the lower abundances preceding cold interval MIS8. The abundance for *G. bulloides* ranges between ~10 to 35%.....".

Page 144, line 14. 'The calculated average size' – I am assuming 'the average size is a SFD'?

Page 144, line 20. I am assuming the 'Foraminiferal stable isotope values (d18O and d13C)' are for single test measurements. Consider changing from 'The oxygen isotope...' to 'Single foraminiferal test oxygen isotope...'.

Page 148, line 6-26. What about the effects/influences of the 'carbonate ion effect, temperature and dissolution' of foraminiferal d18O and d13C?

Page 148, line 25-26. '...is a progressive enrichment in 13C for increasing size.' Could this observation be due to changing sea water temperature of carbonate ion concentration during TIII?

Page 150, line 1-6. It would have been interesting to know the shell normalised mass (weight) of forams between the different size fractions.

Page 154, line 1-25. 'Seasonality' – Are there any sediment trap foraminiferal studies in this region on foraminiferal flux, size, mass, isotopes (d18O and d13C). I suppose a comparison of what might be seen in sediment trap data may provide further insights into the 'mixed' isotope values that are seen in the figures?

Page 154, line 7. Consider changing 'Given the overlap of the larger than >250um...' to 'Given the overlap of the >250um...'

Page 157, line 16-19. The sentence 'Given the seasonal flux...large scale transport.'

C52

It would be interesting to see if there any data (e.g. foram isotopes, flux weight info, size fractions) for the NABE48 sediment. The spread of this seasonal information could be averaged, computed to see if it fits the observations seen in the results presented here?

Page 160, line 16. Consider changing 'This depletion' to 'The depletion for globorotalia species.'

Page 161, line 2. 'how this size-isotope relationship varies....' Consider including 'shell mass' as well?

Page 174, Table 2. Consider changing caption to include information of size fractions. Eg. 'Smallest (212 – 250um) and largest (300-355um) size fraction ..... Page 176. Table 4. There is a typo in table 4. I think '*G. inflata*' should be *G. bulloides*?

Page 178. Figure 1. Consider adding some information on the colour coding for relative temperatures? Eg. Is blue – cold, Orange – intermediate temp, Red – warm? Or to provide information on the temperature range for the colour codes.

Page 180. Figure 3. Consider having (A) – *G. bulloides* single d18O values in a separate figure. There is lots of information in Figure 3 as it is. Also, the title of the figure caption should also be changed. Consider 'Figure 3. Relative abundance and average size of *G. bulloides* (blue), *G. inflata* (red) and *G. truncatulinoides* (green). ....etc.

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C53