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Interactive comment on “Encrustation and trace element composition of *Neogloboquadrina dutertrei* assessed from single chamber analyses, implications for paleotemperature estimates” by L. Jonkers et al.

Anonymous Referee #2

Received and published: 15 August 2012

This paper examines the trace element variability of Mg/Ca, Mn/Ca and Sr/Ca ratios within single chambers of *N. dutertrei* tests from sediment trap, core top and marine sediment cores. The individual chambers are analysed using LA-ICPMS. The paper is of importance because it examines these trace elements in specimens that have calcite crusts, as identified under SEM. The authors show that crust bearing *N. dutertrei* have lower Mg/Ca and Mn/Ca ratios in their outer crusts compared to what is assumed to be higher Mg/Ca and Mn/Ca inner calcite.

This study shows that there are implications to the paleoclimate community where

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foraminiferal species that produce calcite crusts are used. The most obvious is that paleotemperature reconstructions based on whole test averages, where the presence of calcite crusts have not been determined are potentially biased or even amplified where a large number of crust bearing species are present. The bias largely depends on the amount of calcite crust within individual foraminifera, and the number of crust bearing foraminifera within an analytical sample. Therefore, prediction of the bias is difficult to resolve unless micro-analytical techniques such as LA-ICPMS are employed.

However, this paper offers a method to which Mg/Ca variability due to real (as opposed to precipitation of the calcite crust) can be examined in detail in order to test whether Mg/Ca in this species (and others) is actually representative of the ocean temperatures in which they calcified and therefore requires more work in order to test the existing calibrations that have been previously applied to this species.

Although the authors do not offer an explanation as to the how the calcite crust is biominerallised (only that it is perhaps a biological effect), if crust Mg/Ca ratios are treated the same as inner Mg/Ca ratios, the increase of Mg/Ca in the calcite crust with the addition of new chambers in the final whorl, would suggest that the foraminifera is moving up the water column, which goes against the traditional theory that foraminifera move deeper in the water column prior to reproduction/gametogenesis. This is a really interesting observation, and it would be noteworthy to see whether this is also true for other planktonic foraminiferal species.

General Comments

Although the Anand et al., (2003) calibration is applied to the Mg/Ca ratios, it would be more useful to estimate the temperature and convert this to a depth range at which the foraminifera could be calcifying and compare this to the known depth range of the samples. For example, the sediment trap foraminifera should have the seasons constrained, so the Mg/Ca ratios could be used to estimate the depth at a particular month. How do these depths compare to the known calcification depth range of this

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species. Do they fall within the thermocline?

Is it possible to define what is considered an encrusted sample? Is it the presence of blocky crystals? Can you also determine encrusted forms based on the presence (or absence) of pore pits, (size-normalised) weights, infilling of sutures?

Minor Comments (print version)

Introduction

page 2, para 2, line 7 – change intratest to intra-test. *Neogloboquadrina dutertrei* (N. dutertrei) should be in brackets here first.

page 2, para 2, line 19 – change increase to enrich or add ‘increase/enrichment’?

Materials and Methods

page 3, para 2, line 12 – The authors mention Natal Bight with no frame of reference prior to this. Maybe a quick sentence explaining why this feature is important. Also, salinity (line 12 & 13) has no units.

page 3, para 2, line 22 - I think it is important to note somewhere in your methods section that *G. ruber* does not produce a calcite crust!

page 3, para 2, line 27 – change el/Ca to Te/Ca?

Material and Methods

Page 3, para 2, line 19 – Analytical uncertainties of what?

Page 3, para 3, line 25 – Could the high counting rates at the beginning of the LA-profiles be the TE-enriched veneer mentioned in other papers using LA-ICPMS e.g. Eggin et al., (2003)?

Page 3, para 3, line 27 – Which Anand et al., (2003) equation specifically did you apply? You do not show the equation in the manuscript.

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Results

Page 4, Section 4.1 - Change title to Crust and trace element/Ca layering?

Page 4, para 2, line 23 – Maybe change 0.01 mmol/mol-1 to μ mol/mol-1 and also show the min and max change between the layers.

Section 4, page 3, para 2, line 25 – Why do the authors think that the Mg/Ca and Mn/Ca layering is absent in some specimens? Is it because they do not have a crust (or minimal crust)? If this is the reason then you need to state this more clearly in the manuscript. If they were identified as crust bearing but this is not resolved in the laser profiles, could this be related to the methodology e.g. could the high power be ablating a potentially thin but low Mg/Ca (and Mn/Ca) crust?

4.3.2, page 5, line 7 – I don't understand what the (~1%) refers to?

Discussion

page 5, para, 1, line 17 – change el/Ca to Te/Ca

page 5, para, 2, line 27 – change specimen to specimens

Conclusions

page 7, para 1, line 2 – change 'showed that' to 'demonstrated that'.

page 7, para 1, line 4 – in the ante-penultimate chamber of which samples? (is this the mean or median value?).

Table 2 – What is considered low Al/Ca? Please reference and add to material and methods section.

Table 2 - Change '2-layered' to 'double-layered' as this is potentially confusing to the reader.

Figure 9 – I am not entirely sure what the orange symbols/lines mean. I cannot find anything orange in Figure 3, please clarify.

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References

Page 8 - Fehrenbacher and Martin (2010), *G. ruber* is not italicised.

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