

Interactive comment on “A novel salinity proxy based on Na incorporation into foraminiferal calcite” by J. C. Wit et al.

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The paper describes foraminiferal Na/Ca and Mg/Ca ratios measured by laser ablation on single chambers of *Ammonia tepida* specimens that have grown in culture under the influence of partially artificial seawater with well-constrained chemical composition and properties. Culture medium salinity, and to a minor extent, Mg/Ca ratio were the only variable parameters in course of the experiment. Average Na/Ca ratios of specimens kept at different salinities correlated significantly with salinity values. The Na/Ca ratios were introduced as new proxy for salinity in future paleoceanographical studies. Na/Ca salinities may also serve to diminish the salinity effect on Mg/Ca values biasing paleotemperature estimates. The approach is novel, the paper addresses relevant scientific questions within the scope of Biogeosciences and therefore is suitable for

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publication in the abovementioned journal. However, I have some concerns with reference to the concept of the study and applicability of the method, which require further attention and potentially also additional measurements.

- The methods are not comprehensively explained and many details are missing. If one would have the equipment and chemicals at hand, a skilled technician too, and you would like to redo the experiment in order to verify the conclusions or to obtain more data, you were lost. A genuine experiment reported in the literature should be repeatable with the information provided. For instance, I miss a description of the culturing system and procedures, specification of the camera and computer systems for diameter measurements, which cross sections were used to measure the diameter, and details of the software interpreting the elemental cross sections, vitality assessment of foraminiferal specimens etc.

- Comparing tables 3 and 4 it is evident, that the analytical data are not completely documented. A table is necessary listing all specimens analysed, their initial and final diameter, the number of chambers added, their vitality at the end of the experiment, and all elemental ratios. Mean values and standard deviations (1-sigma) for the respective salinities are to be listed as well.

- A sincere concern is that the seawater composition was artificially altered by adding NaHCO₃ and B(OH)₃. This certainly affects the calcification process of foraminifera and hence may bias the shell composition and structure with reference to natural conditions. Higher salinities could be easily achieved by evaporation, similar as it happens in nature every day. A calibration of a paleo-proxy must be done as close to natural conditions as possible.

- Salinities of 36 or 39 units are close to the upper limit of what *Ammonia tepida* could stand (Bradshaw, 1957, his figure 5). Any conclusions drawn from results at these salinities should therefore taken with caution. This circumstance has not been addressed in the present paper.

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- In paleoceanographic studies, elemental ratios in foraminiferal tests are routinely determined with ICP-MS measurements following crushing and homogenisation of 10 to 20 specimens and established cleaning procedures and dissolution of shell fragments. Laser ablation measurements on living specimens record the pristine composition of primary and secondary calcite without subsequent alteration during gametogenesis and early diagenesis in surface sediments. In order to establish the new Na/Ca proxy, the authors must give reference to data obtained by the extensively used wet chemical method on the very specimens grown in culture and compare them with their laser ablation measurements reported in this paper.

- The acceptance and utility of a new proxy will be highly promoted by a sound field test. The authors are encouraged to sample living specimens grown at approximately 20°C from tidal flats where different salinities prevail, for instance from the Danish Wadden Sea in late summer (25 salinity units), French coast of Biscay in early summer (32 units), Gulf of Cadiz in fall (36 units or even more in places). *Ammonia tepida* is found in all these locations with considerable abundances.

- Elemental banding in foraminiferal test walls has been attributed to either vertical movements of specimens in the water column, to adsorption at organic linings in the shell, or to changes in elemental concentration between primary and secondary calcite. In particular the latter point is to be addressed in the discussion.

- The section 4.2 on correcting Mg/Ca based temperatures for salinity is interesting and certainly a leap forward improving the Mg/Ca temperature proxy, but it is out of the focus of the present approach. The section should be omitted.

Minor points:

Section 1, lines 5-10: Jörg Bollmann's (2009) *Emiliana huxleyi* placolith biometry approach is to be mentioned.

Section 1, line 25: should read *Crassostrea* and not *Crassastrea*, and the literature

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reference has to be separated from the species name, it should read: "... Atlantic Oyster (*Crassostrea virginica*) as reported by Rucker and Valentine (1961) ..."

Section 1, line 28: should read "... a more widely distributed proxy signal carrier ...".

Section 3: replace "test size" with "mean value of test diameter"

2nd May 2013, Joachim Schönfeld, GEOMAR Kiel

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