

## ***Interactive comment on “Two-dimensional distribution of living benthic foraminifera in anoxic sediment layers of an estuarine mudflat (Loire Estuary, France)” by A. Thibault de Chanvalon et al.***

**Anonymous Referee #2**

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The methodological approach of this study, although valid and interesting is overshadowed by the presentation of conjecture as observed results of this study. This paper begins as a presentation of a new method to observe foraminiferal abundances and distributions (both vertically and laterally) in addition to pore water geochemistry. Observations of foraminiferal abundances and ecological reactions to bottom-water and pore water conditions are of interest to paleoceanographers and geochemists mainly in the advent and understanding of geochemical indices/proxies ultimately used in the paleoceanographic and paleoclimatic reconstructions. The methodology presented

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in this paper would be of great interest to anyone investigating modern analogues in foraminiferal ecology and geochemistry. The experimental approach seems to be sound although comparison of only a single sample from "the jaw device" and a traditional sediment core seems to be a rather small sample size which would not be appropriate for publication in a study not presenting preliminary results from a new methodological approach.

In the discussion section, this manuscript makes some great leaps from the limited data presented here in an attempt to explain the distribution patterns of *A. tepida*. This manuscript would be of greater interest if it were adjusted to present this new methodological approach and outline its importance in current and future research projects. As it stands the lack of replicates and conjecture presented as conclusions of this study merit major revision.

Suggestions to the Authors:

Abstract- The patterns of Fe are interesting and outlining the importance of high resolution dissolved iron profiles and what they have the potential to illustrate, especially in regards to microfaunal habitats, should be better addressed in the abstract.

Pg 10314 Line 4 includes "(non including diatoms)" is awkward. An alternative wording is suggested.

Pg 10316 Line 10 needs a reference after this sentence.

Pg 10318 Lines 1&2 contain "data not shown". This information should be presented in an appendix.

Pg 10318 Section 2.2 1-D sampling and processing section: In this section Figures 3a and b can be cited. This would result in their coming before Figure 2 and therefore being out of order. Alternatively sections 2.2 and 2.3 could be switched.

Pg 10319 Line 7. The word "simultaneously" should be moved to behind "sediment".

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Pg 10319 Line 17. Consider changing the word "conserved" to something more representative of maintaining viability of the geochemical sampling gel. Perhaps preserved?

Pg 10319 Line 19. Is there any potential of the anoxic gel adversely altering the results of this experiment? For example could it act as a deterrent to organisms in the immediate vicinity encouraging them to move in the opposite direction over the 5hr sampling period?

Pg 10320 Lines 5-9. Error in volumetrics could be avoided if sediments sampled were determined volumetrically (e.g. Rathburn and Corliss 1994).

Pg 10321 Line 4. It would be useful if the number of cubes was stated here.

Pg 10321 Line 21. Rephrase this sentence. Rather than different perhaps state several? This would help clarify the meaning of the sentence. As it stands it sounds like it is being compared to something that you failed to discuss in the next sentence.

Pg 10321 Line 22-Pg10322 Line 2. It would read better if they are was removed from these two sentences. It would then read "When parallel to the cutting plan, burrows are visible over their entire length (e.g. Fig. 4a arrow "a"). When perpendicular to the cutting plan, burrows appear as a dark hole (Fig. 4a arrow 'b').

Pg 10322 Lines 9-10. Are the polychaetes observed in the sediment thought to be the creators of all the burrows in the sample? Are these any characteristics in the burrows that may suggest an inhabitant or creator?

Pg 10322 Section 3.2. Here distributions with unanticipated maxima at depth are presented. Noting the depth difference in the core and the Jaw samples should be included here (5cm vs 8cm maximum depth examined).

Pg 10323 Lines 4-8. If this sentence refers to the geochemical cores discussed in the methodology it may be easier and simpler for the reader to understand if they were referred to as such. "Sediment cores collected for geochemical analysis (as previously discussed in section XXX)..." If it is not already, information regarding the multiple oxy-

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gen profiles taken in these cores (and discussed in this section) should be presented in the methods section.

Pg 10323 Line 12. It may be different for this journal, but typically two parentheses back to back can be included in one single parenthesis and a ; separating the statement and the reference. This is also true for Pg 10325 Line 16 where there is a . separating the statement and the reference.

Pg 10325 Line 12. Add the number 8 between first and centimeters Pg 10325 Line 14. Add ~ before 2mm unless all of your data show an oxygen penetration depth of exactly 2mm.

Pg 10325 Line 25 -Pg 10326 Line 1. This is an interesting statement that merits further discussion. For this methodology to become commonly accepted its usefulness and necessity should be demonstrated and discussed. If this methodology shows roughly similar results, in terms of densities, why should it be adopted rather than traditional foraminiferal and geochemical sampling techniques? A section focusing on this would provide a much more powerful and interesting argument than the inferred reasons for the A. tepida depth maximum between 3-5cms.

Pg 10326 Line 1. Correct. A larger sample size would be much more desirable. Yet, the small sample size does not keep you from drawing wide conclusions not observed but only hypothesized from the small amount of material examined. See discussion of conclusion below.

Pg 10327 Line 1. I suggest inserting "likely" behind "as". It would then read, "This is an unexpected result, since most conceptual models explain benthic foraminiferal distribution in the sediment as likely a direct response to geochemical gradients..."

Pg 10328 Line 2. "modifies" should be "modify".

Pg 10328 Line 21. "this" should be "these".

Pg 10331 Line 14. "proved" should be "proven". Possibly change to

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"...shown/demonstrated in some foraminiferal taxa..."

Pg 10330 Section 4.3. This section can be added to. Here it may be helpful to discuss any observed vertical distribution patterns of foraminifera, especially *A. tepida*, to environmental parameters. How quickly would you expect *A. tepida* to react to environmental changes? Minutes? Hours? Days? (this is discussed a little later but only in terms of oxygen). How quickly, if at all, do you expect geochemical parameters to shift in these areas? One may expect rising tide and changing salinity to alter at least surface water geochemistry. Is there any evidence it changes porewaters as well? Does your sampling scheme reflect the ability to capture this? It would also be helpful to discuss the scale and timing of environmental changes in this region. Samples were taken at low tide on a cloudy day. Would you expect different distributions at high tide? On a sunny day? The distributions you observe here have been observed before. Are there similarities between these study regions and parameters? Were burrows present in these studies as well? The distribution of *A. tepida* was not discussed in these studies but are there any others that discuss a population maxima at depths of 3cm or more? Also, a definition of the 8 vertical replicates should be discussed either here or presented in the results.

Pg 10332 Lines 12-16. The statement for bioirrigation reviving *A. tepida* and that there was no correlation between burrows and living *A. tepida* and burrows seem conflicting.

Pg10334 Line 1. What is the average burrow depth? Does it correlate with the abundance peak of *A. tepida*? A note for this section: This study demonstrates no direct observation of vertical or lateral migration of *A. tepida*. Therefore, statements of foraminiferal migration should be limited to potential occurrences (conjecture) and not presented as your own observations.

The samples obtained in this study are from a 5hour time period. It would be beneficial for the authors to discuss the fact that this represents only a fraction of time during the lifespan of foraminifera. Given where these samples were taken one would think that

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geochemical parameters, even in pore waters, would be likely to change on the scale of days to months. The authors themselves discuss the potential mobility of *A. tepida* in the discussion. A better sampling plan over a longer time period may provide insights into how these organisms react to pore water geochemical changes. As it is the "snapshot" view of *A. tepida* over a 5hr period cannot provide great insights into this at this stage. This study can simply state abundances, distributions and geochemistry within these samples. All other observations drawn from these relationships are conjecture and should be treated as such. The 6 "conclusions" presented in the conclusions section were not demonstrated by this study. They are conjecture derived from observations of this study. It may be possible that this methodological approach could provide insights into these possible reactions of *A. tepida*, however, this manuscript does not demonstrate them directly. The conclusion should be adjusted to better convey this.

Re-writing the conclusion to focus on the new methodology demonstrated here and its usefulness in oceanographic, modern analogue, paleoceanographic and paleoclimatic studies and/or interpretations would be better served. If retained the conjecture in the existing conclusions should be moved to the discussion.

Changes to this manuscript to better present it as the successful demonstration of a new methodological approach would result in a more compelling article. The methodology and effort put into this study should be shared with the scientific community. The Jaw sampling device presented here would be of great interest to a variety of researchers. As it stands the usefulness and potential applications of this sampling method are overshadowed by the rather long discussion, assumptions and speculation involved in explaining the distribution of *A. tepida*. This discussion could and should be shortened up for greater impact.

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