

## ***Interactive comment on “Endolithic Boring Enhance the Deep-sea Carbonate Lithification on the Southwest Indian Ridge” by Hengchao Xu et al.***

### **Anonymous Referee #2**

Received and published: 30 April 2018

The manuscript titled "Endolithic Boring Enhance the Deep-sea Carbonate Lithification on the Southwest Indian Ridge" details observations and analyses of deep-sea carbonate samples that appear to be experiencing enhanced lithification associated with benthic faunal burrowing. The study employs computed X-ray tomography, visual and microscope observation, and geochemistry to evaluate the relationships between burrowing and the degree of carbonate lithification. The main conclusion is that burrowing is likely an important process accelerating carbonate lithification in the deep-sea.

The findings are intriguing and certainly of interest to a wide readership. My main reservations about this manuscript are twofold: (1) it is not immediately clear in some

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CT-scan images that there are density contrasts (enhanced lithification) surrounding the burrows (Figure 4), and (2) it is not clear based on the data treatment that there is true statistical significance in the difference in density between bioturbated zones and control zones (Figure 5). See specific comments on these below.

If the authors can address the above major points then I can see this manuscript being of interest to a wide readership. I agree with the authors that burrowing-enhanced lithification would appear to be an important process if it can extrapolated to deep-sea carbonates world-wide.

While the English is already commendable for authors for whom English might be a second language, and it is possible to follow what the authors are saying throughout the manuscript, there remain minor issues with English throughout the manuscript. This should be easily fixed with a careful proofread by a native speaker.

I would consider the revisions required to address the general comments above and specific comments below to be major - significant blocks of text should be revised and additional statistical treatment should be applied to the dataset.

#### Specific Comments

Abstract, line 9: I'm not sure that one can say that lithification of deep-sea carbonates is a "mystery"; there is a respectable body of literature on lithification mechanisms and rates dating back over three decades. Perhaps better would be something like "the role of deep-sea macrofauna in their lithification remain poorly understood".

Abstract, line 12: "in the sample" makes it read as if there was only a single hand sample, when it appears that grab buckets provided multiple samples. This occurs elsewhere in the manuscript as well.

Abstract line 16: "interested by" doesn't make much sense - please re-phrase.

Abstract, last sentence: these results don't really speak to the importance of deep-sea carbonate sediments, simply the mechanisms of their formation. Please re-phrase.

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Main text in general: while I find that the text is written in a clear and straightforward manner, there remain minor grammatical errors throughout. If English is the authors' second language, then they should be commended - this manuscript already reads decently well. Nonetheless, further editing by a native English speaker is necessary to wrap up the grammatical loose ends that are apparent throughout the manuscript.

Page 2, line 24: it might offend researchers in diverse fields to say that the entire Indian Ocean is "poorly understood".

Page 2, line 30-34: grammatical issues, please re-phrase.

Materials and Methods: certain phrases in the methods have been reproduced word-for-word from previous work. For example, page 4, lines 12 through 14 - these identical lines are also found in Li et al. (2014). Even if the same methodology was used for both studies, it would be prudent to re-word the text in the methods.

Page 4, line 21: there should be no "elution" step in this technique. Also line 22, how was precision evaluated? Repeat measurements of standards? Finally, how were these measurements standardized - using multi-element solutions or by measurement of geostandards? The methods are not sufficiently detailed here.

From page 5 onwards: these are not ferromanganese crusts in the strict sense of the word. Perhaps "Mn- and Fe-oxide precipitates" is a better term.

Page 5, line 10: I suggest re-phrasing this sentence.

Page 6, line 16-17: I suggest re-phrasing.

Page 6, line 24-25: you can't lose a ratio (but you can lower it).

Page 7 line 1: I suggest re-phrasing.

Discussion in general: it would be nice if the authors could elaborate on why a decrease in carbonate saturation state (leading to dissolution) promotes lithification (as opposed to an increase in carbonate saturation state leading to precipitation). Also,

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while aerobic respiration decreases the local carbonate saturation state, sulfate reduction will increase it. Can the authors include a statement about oxygen penetration and the depth of sulfate reduction (even if it is simply based on the findings of others in similar settings)?

Figure 1 Legend: The legend indicates that the red triangle is an inactive hydrothermal field while the caption indicates that it is active - this contradiction needs to be resolved. Also at the end it should read "red circle".

Figure 2e should have a scale bar.

Figure 4b: Contrary to the caption, it is difficult to see any enhanced density in this image.

Figure 4c and d: what do the different arrows represent? In a related vein, for Figures 4 b, c, and d in general - the areas of higher density are not obvious at all. Perhaps circle them or find some better way of highlighting these areas? Also could another presentation method be employed (e.g., an additional panel with contrast adjustments to better show the differences, perhaps shown alongside an un-modified version of the same figure for traceability)?

Figure 5: This is not a statistical analysis in the sense that it does not provide any measure of confidence in the comparison between the two slopes (e.g. whether they can be considered different with 95% confidence). For this you would need to use something like the function "polyfit" in MATLAB (for example). No statistical evidence is presented that these slopes are indeed different... this is a major point as the paper hinges on the importance of burrowing effects.

Figure 8: As a Kiel carbonate device was used, these are not "bulk" C isotope measurements, but C<sub>carb</sub> measurements (same for oxygen isotopes). That is to say, organic matter in the sample is not measured during the analyses when a Kiel carbonate device is used, only carbonate - this should be clarified.

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