

**Editor:** Thank you for submitting a revised manuscript. Two reviewers have now provided comments on this revised version. While both reviewers find the manuscript greatly improved, there are still a number of smaller and larger issues to address prior to publication.

The first larger issue is the English grammar, which should be improved further. While all BG-manuscripts are edited for English in the final stage before publication, a higher initial level is required. Both reviewers provide useful suggestions. If possible, please involve a native English speaker in checking the manuscript. Please note that the title also contains an error: "Enhance" should be replaced by "Enhances". The second larger issue refers to the statistics and presentation of the regression lines in Fig. 5, as pointed out by one of the reviewers.

*We appreciate the work of the editor and two anonymous reviewers. We are thankful for all the valuable comments and suggestions. English languages are edited with the help from a commercial language service. Fig.5 is revised following the valuable suggestions from the reviewers. Below we have pasted in the entire review, and we have inserted our responses to the suggestions (blue font).*

**RC1:** The authors have greatly improved the manuscript and representation of the figures, I just have a few more minor comments, and some technical corrections. The only thing that bothers me a bit is the amount of grammar mistakes and spelling errors in the manuscript. I would strongly advise to proofread the MS to remove as much of these as possible (I have highlighted a few in the technical comments section).

*Thank you very much for your appreciation on the overall performance of the work.*

*Sorry for our poor English writing. We have called for Language service for help with English language editing.*

Minor specific comments:

P1L16: you are more highlighting the importance of bioturbation, not really the importance of deep-sea carbonate rocks

*The sentence has been rephrased:*

*"Macrofaunal burrowing provides a novel driving force for deep-sea carbonate lithification at the seafloor, illuminating the geological and biological importance of bioturbation on global deep-sea carbonate rocks."*

P3L5: did you take any pictures or determined what animals were exactly present in the rocks? I see now you did this in Figure 2, please add it in the method description

*It was unfortunately that we did not take pictures of burrowing animals on the sea specifically. When carbonate samples were spread on the deck, benthic organisms were usually evident among the fractured rocks. Fig. 2c, d were taken from the fractured rocks on the deck.*

P8L14: How exactly does your element and isotope results reveal minor external impact on the lithification?

*REE patterns of the three types of sample did not exhibit any hydrothermal anomalies, e.g. positive Eu anomaly, but inherit the characteristics of sea water by enrichment of HREE compared with LREE and negative Ce anomaly (except the Mn- and Fe-oxide) (Fig. 8). Positive correlation of  $\delta^{13}\text{C}_{\text{PDB}}$  and  $\delta^{18}\text{O}_{\text{PDB}}$  values of chalk and gray excrements ( $r = 0.91$ ) reveals minor environmental influence on early lithification (Fig. 9). Thus, we deduced that the influence of nearby hydrothermal systems and other detrital input to the studied carbonate area should be negligible during the lithification history.*

*“We deduced from elements and isotope results that the influence of nearby hydrothermal systems and other detrital input to the studied carbonate area should be negligible during the lithification history”*

P9L13: same remark as above, you did not illuminate the geological and biological importance of carbonate rocks. You illuminated the importance of burrowing animals on the lithification of carbonate rocks

*The sentence has been rephrased:*

*“The novel mechanism proposed here for non-burial carbonate lithification at the deep-sea seafloor sheds light on the potential interactions between deep-sea biota and sedimentary rocks, and also illuminate the geological and biological importance of bioturbation on global deep-sea carbonate rocks.”*

Technical corrections:

P1L10: a tremendous amount of burrows

*Thanks for your correction.*

P1L10: the ultraslow spreading Southwest

*Thanks for your correction.*

P1L13: enhances deep-sea carbonate lithification

*Thanks for your correction.*

P1L24: may include diagenetic products

*Thanks for your correction.*

P2L8: Benthic fauna burrowing into the substrate plays a critical role

*Thanks for your correction.*

P2L10: you could also cite more recent papers here, e.g., (doi:10.1007/s10498-016-9301-7)

*Thanks for your reminding.*

P2L29-30: promoted deposition of high quantities of carbonate deposits

*Thanks for your correction.*

P3L7: were kept frozen in dry ice

*Thanks for your correction.*

P5L29-30: this sentence is not very correct, pleas rephrase

*It has been rephrased*

*“Therefore, the carbonate deposits on the SWIR could represent bioclastic deposition from “biogenic bloom”, which was the productivity related event in a large part of Indian Ocean during the middle Miocene to the early Pliocene (Singh et al., 2012; Rai and Singh, 2001; Gupta et al., 2004; Arumugm et al., 2014”).*

P8L9 stable CaCO<sub>3</sub> phases

*Thanks for your correction.*

P8L10 that is not likely to happen

*Thanks for your correction.*

P8L21: Berner and Westrich, 1985, American Journal of Science is more appropriate here

*Thanks for your reminding.*

## **RC2:**

Second review of BG-2018-46

I have now completed a second review of the manuscript now re-titled “Macrofaunal burrowing Enhance Deep-sea Carbonate Lithification on the Southwest Indian Ridge”.

The authors have taken the previous round of reviewer comments seriously and the manuscript is much improved. That said, there are still two outstanding issues that were raised in the original review that prevent acceptance in its current form.

First, many minor grammatical errors remain – I have made suggestions for correcting some of the most glaring errors below in the specific comments. I appreciate that special attention has been made to the English in this current revision, and it is indeed improved. However, it still requires further proof-reading for English before it can be considered ready for print. I implore the authors to consider an external proofreading service or other solution that will ensure that the grammar is up to par.

*Sorry for our poor English. We have called for Language service for help with English language editing.*

The second and more important issue relates to the statistical analyses of the change in density surrounding the burrows. While the authors provide R-squared values for their fits, they do not plot the fits, nor their confidence bounds. Instead the current figure simply has lines connecting the points, however the points are not in increasing order, so the lines bounce all around in a zigzag manner. What I am hoping to see is the regression line drawn through the data along with the confidence bounds. See <https://www.mathworks.com/help/stats/polyconf.html> for an example where both the fit line and confidence bounds are shown overlaid upon the data. The basic statistical question is not “does each slope have a robust fit”, which is what the authors currently provide. Instead, the basic statistical question at hand is “are the two slopes significantly different”? This is at the heart of the manuscript – whether bioturbation has a statistically significant influence on density (and thus carbonate lithification). I don’t think these should be prohibitively difficult for the authors to address, and I continue to hold the opinion that this work should be eventually suitable for publication in Biogeosciences. In my opinion we aren’t there yet – but definitely getting closer.

*We are thankful for the valuable comments and suggestions for promoting the quality of data treatment. In the revised version of manuscript, confidence bounds are shown in the figure. With 95% confidence bonds, bioturbated area > 1000 (pixels unit) shows significantly*

difference with unbioturbated area > 1000. Integrated density extracted from the area < 1000 seems not significant.

Integrated density obtained by ImageJ is the summation of calibrated gray values. No matter how large the diameter of each burrow is, we measured the gray values of the 10 pixels (~0.3 cm) around the burrows. Thus, compared to the burrows with small diameter, areas around burrows with bigger diameters are more representative. Nevertheless, the difference of the integrated density can be shown from Fig. 5.

In order to make the comparison more clear, an independent t-test was run on the data (Integrated density/Area ratios in Fig. 5) with a 95% confidence interval (CI) for the mean difference. The mean difference is  $0.488 - 0.588 = -0.100$ . The p-value of Levene's test is  $0.003 < 0.005$ , so we reject the null of Levene's test and conclude that the variance is significantly different. The negative t value in the test indicates that the mean values for the first group, bioturbated, is significantly lower than the second group, control. The 95% CI is  $[-0.0124, -0.0753]$ , which does not contain zero, this agrees with the small p-value (0.000) of the significance test.

	Data numbers	Mean	Std.Deviation	Std. Error Mean
Bioturbated	113	<b>0.488</b>	0.054	0.005
Control	59	<b>0.588</b>	0.087	0.011

	Levene's test for equality of variance		t-test for Equality of means						
	F	Sig.	t	df	Sig.(2-tailed)	Mean difference	Std. Error Difference	95% confidence interval of the Difference	
								Lower	Upper
Equal variances assumed	9.110	<b>0.003</b>	-9.285	170	0.000	-0.100	0.0108	-0.1213	-0.0788
Equal variances not assumed			<b>-8.048</b>	<b>81.633</b>	<b>0.000</b>	<b>-0.100</b>	<b>0.0124</b>	<b>-0.1248</b>	<b>-0.0753</b>

Specific comments

Pg. 1, Line 10: "blanketing the seafloor of the"

*Thanks for your correction.*

Pg. 1, Line 12: "in this carbonate lithified area"

*Thanks for your correction.*

Pg. 1, Line 13: "were examined" ... also "enhances".

*Thanks for your correction.*

Pg. 2, Line 18: This is a bit awkward, I recommend "We examined this intriguing occurrence of non-

burial carbonate... and highlight the interactions...”

*“In this research, we examined this intriguing occurrence of non-burial carbonate lithification in the deep-sea and highlight the interactions that take place between bioturbation and lithification on the mid-ocean ridge.”*

Pg. 2, Line 28: “substantially in”

*Thanks for your correction.*

Pg. 3, Line 19: “which is a public“

*Thanks for your correction.*

Pg. 3, Line 27: “The MATLAB function polyfit was used”

*Thanks for your correction.*

Title of section 5.2: “around burrows”

*YES, Maybe you refer to the section 4.2 and it has been changed.*

Pg. 5, lines 29–31: There are multiple grammatical problems in this sentence.

*It has been rephrased*

*“Therefore, the carbonate deposits on the SWIR could represent bioclastic deposition from “biogenic bloom”, which was the productivity related event in a large part of Indian Ocean during the middle Miocene to the early Pliocene (Singh et al., 2012; Rai and Singh, 2001; Gupta et al., 2004; Arumugm et al., 2014). ”*

Pg. 6, Line 4: “from SEM images”

*Thanks for your correction.*

Pg. 6, Line 20: “hydrothermal systems and detrital input”

*Thanks for your correction.*

Pg. 7, Line 24: “bulk samples are”

*Thanks for your correction.*

Pg. 7, Line 31: “deep-sea environments”

*Thanks for your correction.*

Pg. 8, Line 7: “of the studied carbonate area”

*Thanks for your correction.*

Pg. 8, Line 9: “phases”, then line 10: “this is not likely to occur here”

*Thanks for your correction.*

Pg. 8, Line 12: “However, the carbonate samples studied here have never been buried”

*Thanks for your correction.*

Pg. 8, Line 15: “Moreover, ecological niches”

*Thanks for your correction.*

Pg. 8, Line 18: The beginning of this paragraph has grammatical problems.

*Thanks for your correction.*

Conclusion: Multiple grammatical issues.

*Thanks for your correction.*

Figure 5: There are lines connecting the points that show a zig-zag pattern as they trace the order of the points without any sorting. In other words, they are simply connecting the points in a random order. These lines should be removed and the actual fits presented (the trendlines that go through these point clouds, which are not currently shown).

*Thanks for reminding. Fig.5 has been edited following your suggestion.*

