Biogeosciences Discuss.,
https://doi.org/10.5194/bg-2018-111-RC1, 2018

Biogeosciences
Discussions

Interactive comment on "The Ballast Effect of Lithogenic Matter and its Influences on the Carbon Fluxes in the Indian Ocean" *by* Tim Rixen et al.

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Received and published: 18 April 2018

Rixen et al., present analysis of a sediment-trap dataset from the Indian Ocean in combination with experiments using a carbon cycle box model to explore the role of lithogenic material as a ballast material for particulate organic carbon. I submitted an open comment on a previous version of this manuscript and in general I think this manuscript has been improved with respect to structure and the inclusion and streamlining of specific methods. The general concept of the manuscript is interesting as the Indian Ocean has previously been identified as an area where the role of lithogenic ballast material may be significant. As such, the analysis of sediment-trap data is novel and potentially has some interesting findings but some of the interpretations are either not sufficiently explained or are derived from assumptions that are not sufficiently

supported. In contrast, I do not think the box model is an appropriate tool to explore lithogenic ballasting. On balance, I would suggest a future revision focusing on the data only would be of interest but the current assumptions and interpretations need considerable rethinking so I recommend the manuscript be rejected. I have provided general comments below that are specific to the reasons for rejecting and have attached a pdf copy with specific comments.

General Comments:

Sediment Trap Analysis:

There are elements of the analysis I find interesting and informative. The calculation of carrying coefficients, both on global annual and individual intra-annual scales, is interesting and relevant to previous work. I would suggest this appears first in the results as it is the closest to previous publications. The use of calculated sinking speeds is also interesting and much clearer than the previous version. However, I do not think alone it can be conclusive about lithogenic ballasting because it's very dependent on the chosen density values which needs more exploring.

Part of the interpretation of the sediment trap data seems to be based on the assumption that the Henson et al., (2011) estimate of export production is actually representative of POC fluxes to depth (Pg 15, lines 11 – 12 25, Figure 6). No discussion or supporting evidence for this interpretation is given by the authors and it is not consistent with its use in other papers (e.g., Henson et al., 2012,). It is also not appropriate to change the parameter values of the Henson estimates given this is a statistical fit to data (Pg 15, line 8). Rather than reinterpret or modify the equation, it would be better to consider that the statistical model does not fit as well in the Indian Ocean.

The treatment of data for Figure 7 is also unclear. The authors fit a Michaelis-Menten function in Fig. 7a, but it is not clear how this was fitted. It does not seem to capture the trends at low primary productivity. It is also not clear why the authors choose this function over other functions and what mechanistically the function implies about

POC fluxes. I do not understand the step to calculate excess POC from this function shown in Figure 7b as it is not explicitly described in the text. As described it sounds like the calculation of residuals between the data and the function but this raises questions about why they are not equally distributed around zero and why this is related to lithogenic material.

Box Modelling:

Overall, I think that the modelling section would be better separated into a different manuscript which explores it in much more detail using a model with a higher spatial resolution. The modelling section does not fit within the manuscript well as it is global in nature (not Indian Ocean) and the data does not quantitatively inform the model or experiments.

The authors change both the remineralisation of organic carbon in the ocean interior and the magnitude of export production in the 3-box carbon cycle model. However, these experiments are not constrained by information about lithogenic fluxes, e.g., it is not stated why increasing the fraction of POC reaching the deep box from 10

The lack of spatial resolution in the box model is also problematic because fluxes of lithogenic ballast material (atmospheric deposition and riverine fluxes) are spatially variable and because of the importance of the Southern Ocean in the formation of preformed nutrients (as noted by the authors in the introduction). There is also no description of how preformed nutrients are included in the model in the methods section and so it is unclear how interpretations referencing preformed nutrients are made.

References

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Please also note the supplement to this comment:
https://www.biogeosciences-discuss.net/bg-2018-111/bg-2018-111-RC1-supplement.pdf

Interactive comment on Biogeosciences Discuss., https://doi.org/10.5194/bg-2018-111, 2018.