Biogeosciences Discussions

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Comment on bg-2021-318

Anonymous Referee #3

Referee comment on "Linking sediment biodegradability with its origin in shallow coastal environments" by Justine Louis et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-318-RC3, 2021

Review of "Linking sediment biodegradability with its origin in shallow coastal environments**" submitted to BG by Louis et al. (bg-2021-318)**

The objectives of the study included assessments of the variability of sedimentary organic matter (SOM) origin at the regional scale, determination of the link between SOM origin and its biodegradability, and how the OM sources can drive nutrient dynamics at the sediment-water interface.

General comments

The mineralization rates were measured under oxic conditions. Since the *in situ* oxygen penetration depths into these coastal sediments likely only were a few mm, why were the mineralization rates only measured under oxic conditions? Most of the mineralization most probably took place under anoxic conditions. In other words, do the mineralization rates you report really reflect *in situ* ambient conditions?

The number of sampling sites (45) of this study is impressive.

The authors are not native English speaking people, so it may be hard to produce a linguistically correct text. However, to avoid confusion and misunderstanding, the English text should be checked and improved throughout the manuscript by someone with English as mother language.

There are several typos in the manuscript. Please correct throughout.

Specific comments

Line 41: It is Santschi, not Santshi

Lines 176-184: It is not enough to only refer to a previous paper on how the benthic fluxes were measured. Much more details are needed to be provided in the present paper on these measurements. For example:

How was oxygen concentration in the overlying water measured during these incubations?

How well was oxic conditions maintained in the overlying water? What was the range of oxygen concentration measured during the incubations?

How many samples were withdrawn from the overlying water during the 4 h incubations?

The overlying water was replaced by 150 mL of nutrient-free artificial seawater; this must have created a larger concentration gradient across the sediment-water interface compared to *in situ* conditions with ambient bottom water not being "nutrient-free". **So, are the measured benthic fluxes artifacts and much higher than *in situ* fluxes?**

What was the difference in salinity between the artificial seawater and the ambient bottom water?

Lines 375-376: What do you mean with *potential* benthic nutrient fluxes? Please explain.

Lines 564-565: "The realistic redox conditions of the sediment were preserved during the core incubation". Please explain how you can state this. What grounds and which data can you demonstrate to support this statement? For example, what was the oxygen penetration depth in the sediment during the core incubations and how did that depth compare to the *in situ* oxygen penetration depth?

Lines 616-617 and Conclusions: …"we must keep in mind that a large part of the variance of benthic NH4+ and PO4 fluxes on the regional scale remains unexplained here (66-67 %)". To how large extent can this unexplained part be due to the fact that you created artificial conditions during the core flux incubations by having nutrient free overlying water? See also my comment above.

Lines 619-622: "In addition, the bioturbation, mediated by the macrofauna activities, was likely preserved in the sediment core incubations and therefore may be involved in the spatial variability of NH4+ and PO4 fluxes". *Preserved*? Do you mean *present*? Again, please use the correct word in English to avoid confusion and misunderstanding.

Final overall comment

I am not convinced that the results (mineralization rates, fluxes) reported reflect ambient *in situ* conditions; they may thus be artifacts. If they are, the messages conveyed and the conclusions presented in the manuscript may not be correct. Can the authors please better explain (taking my comments above into consideration) why they think the results of their study reflect ambient *in situ* conditions?

Recommendation

The manuscript should undergo a major revision based on my comments above followed by a second round of review.