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Biogeosciences Discussions

# *Interactive comment on* "Enhanced rates of particulate organic matter remineralization by microzooplankton are diminished by added ballast minerals" *by* F. A. C. Le Moigne et al.

**Anonymous Referee #3**

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"Enhanced rates of particulate organic matter remineralization by microzooplankton are diminished by added ballast minerals" F. A. C. Le Moigne, M. Gallinari, E. Laurenceau, and C. L. De La Rocha

This paper investigated the combined and separate influences from calcite and microzooplankton on organic matter remineralization within aggregates. This is the first time the combined effect of both mineral ballasting and microzooplankton has been investigated on aggregate degradation. The major findings of the study were that ballast



minerals lowered the regeneration of ammonium and phosphate from microzooplankton grazing. Both the presence of ballast minerals and microzooplankton increased the aggregate formation, hence potentially leading to increased sinking flux. The experiments is carefully planned, executed, and described. Both the material and methods and the results parts are very well written. However, the abstract, introduction, and discussion parts could benefit from a little polishing which make the readability of the manuscript much better. At a few places the discussion would benefit from a stronger link to in situ with either an extra paragraph or just a sentence or two added to the end of existing paragraphs (see detailed comments). Overall I find the manuscript and its investigations good and with a little more work this will be a good paper presenting very interesting results of the interactions of both zooplankton activity and influences from ballast minerals on the export and recycling of aggregates organic material.

Detailed comments Abstract: Page 3598, line 5-7: This sentence could be written more clearly so that it is easier to follow. Introduction: Page 3599, line 26: Change "effects" to "affects". Results: Page 3604, line 23: Change "is" to "was". Discussion: Page 3606, line 10-12: Strictly speaking it is not a balance. Erase "the balance between". Page 3607, line 11-16: The abundance of rotifers used in equation 1, is that the amount added on day 0, or the amount counted from the sampling on day 8? Please make that clear in the text. Page 3608, line 16-18: The physically interfering with grazing is then simply due to the rotifers filling their stomach with inorganic calcite resulting in lower regeneration of ammonium and phosphate. Would the organic-specific rates of regeneration therefore be the same if normalizing to the ingested amount of organic matter? This was not measured, and difficult to estimate, however, this could indicate that the lower remineralization rates in the presence of ballast minerals is not due to the inhibiting effect directly, but simply due to the "ballasting effect" of filling their stomach with non-organics. The end result is of course the same, but this is also interesting for areas with his silt in the water, i.e. river inputs, glacier melting etc. A small paragraph elaborating on this would be interesting. Page 3608, line 20 onwards: It is interesting that the presence of rotifers lead to higher aggregate formation (comparing P and PZ).

Did the rotifers themselves form aggregates together with the diatoms? For the ballast minerals (the calcite) the increased concentration of suspended particles in the water could be the main reason for the rapid aggregate formation. Can you include a small part of the P versus PZ treatment in the discussion, in addition to the little mentioning in the results? Page 3609, line 4-13: As the authors state, the rapid formation of ballasted aggregates would potentially lead to elevated export. Is it likely that there would not be any differences after 8 days between a mineral ballasted and non-ballasted situation. As the authors state, the aggregates would rapidly sink out. Therefore, by keeping the aggregates in suspension within the same water volume over 8 days in the roller tanks allows the ballasted aggregates to become looser due to degradation and continuously disaggregation and re-aggregation while the non-ballasted aggregates potentially could become more compact due to degradation and scavenging. So despite no obvious differences in amounts of aggregated organic matter at the end of the incubation, it might be worth to consider these observations in relation to a more natural in situ situation. Meaning that the production of DOC from POC would likely occur at depths for the ballasted aggregates, while the non-ballasted aggregates could still have high DOC production within the mixed layer of the upper ocean. Maybe add a sentence or two after like 20 on page 3609? Figures: Figure 5 is a bit unclear in the figure legend. It would make it clearer if you point out that the suspended and aggregated particulate compounds is there to show how the total particulate part is distributed.

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Interactive comment on Biogeosciences Discuss., 10, 3597, 2013.