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Biogeosciences Discussions

Interactive comment on "Reviews and Synthesis: To the bottom of carbon processing at the seafloor" *by* Jack J. Middelburg

Anonymous Referee #1

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This paper describes well the linkages between biogeochemistry, organic geochemistry and ecology at the seafloor. It is obvious that these disciplines have strengths and weaknesses, and if they are combined, a much more detailed view of the variety of benthic processes and their interactions can be obtained. The paper emphasizes this in an excellent manner.

Major concerns

My major concern deals with the inclusion of paleoceanography among the disciplines under study. Actually, this discipline is only mentioned in the abstract and the beginning of the introduction, while there is no mention of this in the remaining part of the manuscript. I recommend omitting paleoceanography from the abstract, introduction and figure 1. The focus should then be on biogeochemistry, organic geochemistry and

ecology throughout the paper.

It seems implicit from the text that the research in the three disciplines has been done in isolation only (see lines 64-72). The author should mention that many papers actually have focused on the interface of two or even all three disciplines.

In chapter 2, the title starts with "Geochemists focus on. . .". In this chapter and throughout the manuscript the term geochemistry is used. I suppose that it should be biogeochemistry? Otherwise it makes no sense with the introduction of the paper. It becomes even more tricky when the next chapter deals with organic geochemistry. The reader can easily be confused. I recommend using "biogeochemistry" and "organic geochemistry" to separate these disciplines throughout as defined in the introduction and figure 1.

The introduction of bioturbation in lines 116-122 is not fully clear and does not follow the recommendation and definition introduced by Kristensen et al. (MEPS 446: 285-302, 2012). In this paper, it was argued that bioturbation covers both particle reworking and bioirrigation driven by ventilation. I recommend following this definition throughout the paper. It does not change the meaning, but merely clarifies the terms. Moreover, it is striking that only Aller is cited when ventilation is discussed. Other and more recent papers have been published on this subject.

I miss the role of ventilation driven bioirrigation in chapter 5.4 where animal stimulation of microbes is dealt with. Several papers have shown that the subduction of oxygen into burrows by animal ventilation has the capacity to enhance microbial processes, including a stimulation of decomposition of old and buried organic matter, by up to one order of magnitude. I recommend that this aspect is dealt with here.

Minor points

Line 19: Change to "It is shown. . ." Line 51-52: Change to ". . .of substances that have survived. . ." Line 54: Change to ". . .of the material that is eventually. . ." Line 55-

57: Change to "...remaining part is recycled as key nutrients (e.g. N, P, Si, Fe) to sustain primary production in the water column..." Line 64: Change to "...topic, e.g. fate of organic matter..." Line 69: I disagree with this definition of bioturbation – see above. Line 72: Delete "their food" Line 77: Now we are introduced to four disciplines (two new!!): Organic geochemistry, sediment geochemistry, ecology and microbiology!! Please place them into the context of the three primary disciplines the entire story deals with. It is particularly important as this statement is presented in the last paragraph of the introduction. Line 86-87: Change to "...overlying water, or is buried..." Line 92: Change to "...rates are high in vegetated..." Line 96-97: Change to "...degraded to inorganic carbon at rates that provide an..." Line 130: Now we are introduced to microbial ecology as a discipline – how is that connected to the three major disciplines of this paper? Line 134-138: These lines make no real sense and should be rephrased or omitted. Line 139-140: Change to "...and porewater depth profiles..." Line 149: Change to "...and anaerobic organisms, including the distribution..." Line 152: Delete "these" Line 177-178: Change to "...or its reverse, the refractory nature of organic matter, with various..." Line 179: Change to "...amino acids..." Line 186-187: Change to "...organic matter by bacteria (Cowie and Hedges..." Line 190-191: Change to "...importance of bacteria and fauna for organic matter..." Line 193-194: Change to "...secondary production (Cowie and Hedges..." Line 202: Change to "...(e.g. macrofauna, meiofauna and microbes..." Line 216: Change to "...considered the key to..." Line 218-223: The element dealt with here must be carbon as respiration is mentioned. Please specify. Line 231-233: This last sentence appears to be out of context. Please omit or rephrase. Line 244-245: Change to "...particles around by reworking and enhance solute transfer by ventilation driven bioirrigation." Line 245-248: Change to "The ingestion of food eventually results in compositional changes of the organic matter, but there is little information that the identity of the processing organism matters much." Line 252: Change to "...transfers within the food web..." Line 287-288: change to "...flow through the living compartment is much higher..." Line 292-293: Change to "...and microbes (Middelburg et al..." Line 313: Change to "On one hand..." Line

318-321: These statements are quite contradictory. Which one to believe? Line 323-324: Change to "...microbial processing of deposited organic matter represents a major carbon flow and..." Line 328: Change to "phosphorus" Line 327-331: Somehow these lines are in conflict. First it is mentioned that decomposition results in preferential release of N and P, then it is implied that accumulation of microbial organic matter decreases the C/N ratio. These two processes cannot occur simultaneously. Please clarify. Line 328-335: Please be consistent in the notation. In this section, ratios are partly notated C/N and C/P or C:N and C:P. Use the same throughout. Line 350: Who are "we"? The paper has only one author! Line 386: Change to "...primary producers..." Line 401: Delete "more" Line 420-425: Just a comment – It has long been known that all invertebrates have the capacity to take up DOC. So, this is not only valid for sponges. Line 473: Change to "...also because bioturbation is absent..." Figure 1: Please omit the paloceanography panel – it is not dealt with in the text. Figure 4: Please explain what the red-orange-yellow colors stand for.

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