We would like to thank all reviewers for their critical comments, which we think helped to improve the quality and clarity of this manuscript. We hope our responses and adaptations are adequate to accept this manuscript for publication in Biogeosciences. Please find our detailed responses below.

Anonymous Referee #2

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The manuscript of Maltby et al. describes rates of sulfate reduction and methanogenesis were measured in various radiotracer incubations. The study highlights the role of methanogenesis in near-surface sediments (here termed shallow methanogenesis) in overall carbon mineralization. Methodologically the study is extremely well designed and the experimental setup is flawless.

The only flaw that I see in this paper is in the treatment of the bag incubations in relation to the whole-core incubations. While whole core incubations are next best thing to in-situ experiments with benthic landers (which come with their own set of problems and limitations), bag experiments for rate measurements will definitely give results that are different to measurements on intact sediment cores. Numerous studies have reported the effects of structural disturbance on turnover rates. Although the bag experiments were only perfomed in order to study the effect of various substrate additions, especially non-competitive subtrates, the measured rates are presented in a way that the reader might get the impression that these rates are actually comparable to the whole core incubation data. I would therefore suggest to stress the differences between the whole core and bag incubations and discuss the limitations of the different techniques.

Authors Reply: We thank the reviewer for this helpful comment. There is indeed a difference between the sulfate reduction rates (whole core method) and the net methanogenesis rates (slurry incubations with anoxic deep water). The additional experiments with addition of substrate (slurry incubations with artificial seawater) are marked by a different title: "potential methanogenesis"), which stresses the difference compared to net methanogenesis and sulfate reduction. However, we agree that we have to point out the differences in net methanogenesis rates and sulfate reduction rates during our comparison. Therefore, we added this information to the discussion.

Minor comments:

p14872, line 26: Why do these conditions favour methanogenesis, anoxia and fresh organic matter are also perfect conditions for sulfate reduction

Authors Reply: Methanogens have a high sensitivity to oxygen (sulfate reducers tolerate oxygen much better). We argue that the depletion of oxygen in the bottom water (and with that also absence of bioirrigation) allow methanogens to colonize and thrive close to (or at the) sediment-water interface. We added a few words to clarify this point.

p14873, line 2: As far as I know Limfjorden sediment is permanently anoxic, at least below the upper few mm, only the oxygen concentration in the water column changes over the year. I think this sentence should be rephrased to avoid confusion.

Authors Reply: We agree with the reviewer and changed the sentence.

p14875 line 8 and 15: Why did you process the samples in two different cold rooms with different temperatures?

Authors Reply: This was a matter of space. The cores from the multicores were all processed in a 9°C cold laboratory container, which was used by different scientific parties on board. When we processed the gravity core, space was limited so we moved to the 4 °C cold room (a storage room), which was not acclimated to 9°C.

p14875 line 11: I still think that you paid for the barrel on your corer and did not steal it...

Authors Reply: Done.

p14878, line 21: What do you mean by "transfered completely"? Did you do a quantitative transfer or did you fill the bottle without headspace?

Authors Reply: We filled the bottles without headspace. To avoid confusion, we changed the sentence.

p14879, line 27f: Section 2.3 describes porewater sampling, not rate measurements. What do you mean by "according to the above scheme"? Did you use a slurry? How did you get the sediment into the glass syringes? Or do you mean the old Jørgensen glass barrels (Glass tube with syringe plunger)?

Authors Reply: "According to the above scheme" refers to the sampled sediment depths, not the type of measurements. We changed the wording to make it clearer.
By "glass syringes" we indeed meant the Jørgensen glass barrels. We changed the sentence accordingly.

p14880, line 9f: Why did you do change your technique? I always thought that the old one was just fine?

Authors Reply: Absolutely. It is basically the same method just that for the methanogenesis rate calculation you need the total DIC concentration and not the total methane concentration (which you need for AOM calculation). We therefore did DIC analyses instead of gas chromatography.

p14887, line 12: Why didn't you use for example the SO4 or DIC PW profile to align the cores? Comparison between the topmost Gravity Core sample and the MUC cores should give you a reasonable estimate how much sediment was blown off by the Gravity Core

Authors Reply: We did look at the SO4 profiles to check if the statement of ~ 20 cm fits in our case. However, as the sampling intervals in the gravity core were rather large, we did not feel comfortable to align the cores.

p14889, line 13-15: Please show the data, this could be important.

Authors Reply: As the deep sediment layers are not the focus of the presented study, we do not think adding the iron data will change the view on our findings and rather distract from our story. We therefore refrain from showing this data.

p14890, line 21: To me the term "transport velocity" implies an active movement, which would only be important in zones with active fluid flow. Here we are talking about purely diffusive systems and I would recommend sticking to those to avoid confusion.

Authors Reply: In this context (introducing the SMTZ) we actually meant both diffusive and advective transport. We changed the wording to "flux" as a more neutral term, which considers both diffusive and advective transport.