

Interactive comment on “Fracture-controlled fluid transport supports microbial methaneoxidizing communities at the Vestnesa Ridge” by Haoyi Yao et al.

Haoyi Yao et al.

haoyi.yao@uit.no

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Authors reply to Referee #2:

We thank the anonymous reviewer’s positive comment and suggestion. Below we reply to the comment and suggestions one by one.

Referee’s comment (RC): However, the following points need to be relooked at

RC-1. Clarity needs to be brought into the naming of the cores, their depth, site distance from each other.

AR: We thank the referee’s comment; we will change the text and introduce core loca-

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tion depth and distance to each other more thoroughly in order to clarify the similarities and differences among the investigated cores. We will also give an earlier reference to Tab. 1 and Fig. 1 where these details are shown.

RC-It is unclear when the non-seeping reference site and a high flux Hydrate ridge site is used in the manuscript for comparison.

AR: We compare our findings to a hydrate ridge core (described in Briggs et al., 2011), as this also contains a mini fracture. In fact, Briggs et al., describe the only other sites where such mini fractures were found, thus these are highly relevant for comparison with our study. We will highlight this in more detail in a revised version of the MS.

RC-It is unclear whether only the Lomvi pockmark core has a mini fracture or the other cores also had and to what extent. Also when a comparison is done between cores with respect to the fracture zone it's important to know how intense was the fracture in all the cores compared and then that can be discussed with respect to the microbial community therein.

AR: Only the Lomvi pockmark core was found to have a fracture. We have stated this already in the original MS (e.g. first line of the abstract) but will edit the result section to highlight that the other cores did not contain a fracture. We found/observed this fracture by X-ray scanning onshore, and because of the gas expansion during core retrieval, it is difficult to estimate how intense the fracture was in situ. We would thus like to refrain from further editing the text in this direction.

RC-2. Please explain the precaution taken during coring so that the reliability of the extent and presence of a mini-fracture is confirmed.

AR: When coring, our aim was initially not to retrieve a core with fractures. E.g., we did not perform autoclave-type coring that would be necessary to retrieve gaseous cores without alterations due to gas expansion. We will mention in the revised version of the MS that such coring techniques would be necessary to better investigate fracture fea-

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tures at quasi in situ conditions. We have mentioned in the text that X-ray analysis can be used to confirm the existence of a mini-fracture in regular multicorer type cores, but the original size and extent of this fracture remain uncertain because of gas expansion during core retrieval.

RC-3. Also there are contradictory findings in this manuscript which needs to be justified appropriately rather than just be assumed.

AR: We are not sure what the reviewer refers to, but presume that our seemingly contradicting findings of increasing methane concentrations in core 893MC, which were not paralleled by signals indicative for AOM (such as an increase in alkalinity, decrease in sulfate and increase in biomarker signals indicative for methanotrophic microbes) are meant – see page 5, line 22-29 in the original MS. We attribute this finding to a rather recent increase in methane flux and the opening of the fracture leaving to little time for an AOM community development. In the revised MS, we will further clarify that this is the ‘least parsimonious explanation’ because under thermodynamic considerations, AOM would be favorable in this setting. Thus, the absence of this process and the absence of a well-developed AOM community is best explained by the very slow growth of AOM communities. Indications for alternative factors that could explain this contradiction, e.g. AOM inhibition due to high salt concentrations (see e.g., Steinle et al., 2018) were not found here.

RC-3. Pg 3 Line 31 & Line 40 Repalce the word ‘home’ with the name of the laboratory

AR: The text will be modified to “the onshore geology laboratory at UiT.”

RC-4. Pg 3 Ln 36 In the methodology the statement ‘Details of the titration protocol can be found in Latour et al. (in review)’ is not reader friendly as the paper is under review so it would better to specify the method used.

AR: We will update the text with a brief description of the titration method.

RC-5. Pg4 Ln 13-14 there are three references sited which part of the protocol has

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been taken from which reference is not clear to the reader, either it should be given clearly or details should be elaborated in the methodology section.

AR: We will modify the text as follows: Lipid biomarkers were extracted and further analyzed according to a previously reported protocol in Elvert et al. (2003), with modifications for alcohol derivatization (Niemann et al., 2005) and instrumental setup (Blees et al., 2014).

RC-5. Pg 5 Line 5-7 Needs reframing to bring out clarity to the reader

AR: see the previous reply-3.

RC-6. Pg 4 Line 5 What does the word 'highest' mean, it can range from any number, please specify quantitatively

AR: We will change the wording to '... that AOM activity at the location of core 008PC was higher than at the other two coring sites.'

RC-7. Pg 4 In 37. It is not clear how methane concentrations were determined from the fracture zone.

AR: This sentence was a bit misleading and will be changed for more clarity in the revised MS. Methane concentration were measured in a parallel core.

RC-8. Pg 5 In5-7 Though the contradictory observations are attributed to the recent development of the fracture, it is not clear as to what could be the time period for the word 'recent'.

AR: See above. AOM communities were found to have doubling times of month. Thus the development of an AOM community with 10¹² cells per ml sediment or more as is typical for highly active AOM sites, would take years. The absence of such a community at the Lomvi coring site thus indicates that the fracture opened no longer than some years ago. We will include this in the revised text.

RC-9. Pg 5 In 28 The authors are assuming a process. It would be better if the authors

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only explain the possible conditions or mention the factor that could lead to such a function.

AR: In the original MS (page 5, lines 22-25), we have outlined that bioirrigation as well as a recent increase in the methane flux could lead to non steady-state sulfate and methane profiles. Indications for moderate bioirrigation (due to the presence of tube worms) were found and also a recent increase in the methane flux is not unlikely, so that both factors could account for this.

RC-10. pg 6 ln 20 pls specify the location

AR: The text 'the location' will be changed to 'the Lomvi pockmark in Vestnesa Ridge'.

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