

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

Anonymous Referee #1

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In this manuscript the authors reveal the geomicrobiology of a fracture in the top 10s-cms sediment of the Vestnesa Ridge in comparison to that of two other unfractured sediment horizons. They use pore fluid and gas phase geochemistry, and lipid biomarker, data to elucidate the geomicrobial processes of these sediments. The subject matter and findings of this study would be fully suitable for publication after the following few concerns are addressed. 1. The authors have used multicorer and push-coring techniques to retrieve the sediment samples. The fractured core (893 MC) in particular was retrieved by the multicorer. While it remains uncertain as to how faithfully a 40 cm core retrieved by this process can preserve small-scale fracture networks and present them for analysis, the authors too seem to have appreciated the

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possibility that high internal gas pressure released at the time of the exposure of the core to atmospheric pressure (which is far low than its in situ pressure) may have expanded the fracture. The most remarkable fact, also according to the authors, is that despite the above issues, methane significantly increases in concentration as we go up the fracture from the bottom (Fig. 4). My concern is that the text offers no clear explanation regarding why methane concentration is higher near the sediment surface than at the bottom. Whilst a robust explanation of this is absolutely necessary, I would additionally recommend that the lipid biomarker study be complemented with metagenomic and/or metatranscriptomic analyses to reveal the microbial communities more objectively.

2. For smoother reading and comprehension of the present manuscript, the authors should coin such identifiers (or names) for individual sediment cores that harness both the core numbers as well as the coring-site names.
3. In the Methods section, the procedure for measuring methane concentration (the central parameter of this study) must be described and not entrusted entirely on cross referencing.
4. The labels of Figure 2 and 4 lack resolution.
5. Page 1 Line 22: I think the readers will find it easier to navigate the data if you say here “In a separate un-fractured core, recovered from the same pockmark approximately 80 m away from the fractured core, we observed”.
6. Page 1 Line 34: “Increased sediment permeability due to fractures may facilitate gas and fluid transport.” – I think one should also consider seepage of sulfate, nitrate, etc. from the water into the sediment. Next sentence: no need to start with “Indeed”.
7. Page 2 Line 4: Words like “tremendously” are subjective and judgmental so should be avoided.
8. Page 2 Line 5: Instead of obscure words such as “consume methane”, or “benefit from sulfide” one should use specific terms as “oxidize”.
9. Page 2 Line 13: What does “poorly constrained” mean here? In the context of the sentence, how can the significance of something be poorly constrained?
10. Page 2 Line 14: “maintain their metabolism” is technically not a right phrase; better say, “. can then be used by sedimentary microbes as metabolic / bioenergetic substrates”.
11. Page 2 Line 23: “thus” or “therefore” should come before “play”.
12. Page 2 Lines 27-28: “Using an interdisciplinary approach that combines

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geochemical and biogeochemical measurements, we investigate the” – There can be nothing like “biogeochemical measurements”; the whole thing is biogeochemical, so geochemical and biogeochemical are two redundant words; moreover lipid profile is a microbiological issue, and when combined with isotope ratios the issue becomes geomicrobiological. So this phrase should be written as, “. geochemical and geomicrobiological methods” 13. Page 2 Line 37: Must introduce the reader to what “pockmark structures” are; can’t pass on the onus of explaining this key concept to other citations. 14. Page 3 Line 4: ‘Enhanced reflections and “push-down” features’ – Please explain these terminologies so as to make the paper more comprehensible and attractive in its professed interdisciplinary context. 15. Page 3 Line 6: “High excess” – it’s a redundancy of words; just say “Excessive pore pressure”. 16. Page 3 Line 31: “.X-ray analysis in our home laboratories” – I think the authors meant “in the on land laboratory (rather than in the on board or on ship laboratory)”; so it should be written that way. Otherwise it seems that the authors had installed the Geotek MSCL-XCT in their homes. 17. Page 4 Line 36: “Nevertheless, methane analyses revealed a significant increase in methane concentration along the observed fracture (Fig. 4).” – When you just say “along the observed fracture” and don’t mention the trajectory (whether from top to the bottom or upward from the bottom) then the reader gets to construe the first. But actually from top to the bottom of 893 MC, methane is not increasing rather decreasing. So please mention the specific trajectory. 18. Page 7 Lines 3-4: 5. “Assuming a uniform source methane value of XX for the Lomvi pockmark, site 008PC showed the highest $\Delta\delta^{13}\text{C}$ values (Fig. X).” – major oversight behind this incomplete statement – please rectify (what would be the value of XX?). 19. Table 1 should have a one-line description in relation what is listed in it; for instance, location of coring-stations, seafloor habitat information, analyses performed for individual sample-sites, etc. Incomplete / abbreviated expressions, such as “bac. mats & carb” for crucial habitat-related information, in Table 1, should be avoided. In Table 1 it is appearing that methane concentration and lipid biomarker analysis were not determined in the whole study although that was actually not the case; please

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amend.

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