

## ***Interactive comment on “Occurrence and distribution of ladderane oxidation products in different oceanic regimes” by D. Rush et al.***

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The ladderane fatty acids are a fascinating group of compounds having very unusual and distinctive structures. They appear to be excellent biomarkers for anaerobic ammonium oxidation (anammox) due to their apparently unique occurrence in Planctomycetes bacteria. However, as with all biomarkers, the effects of degradation in the water column and sediment needs to be assessed before the biomarkers can be used with confidence in different environments. Previous studies have demonstrated that they can be degraded to shorter-chain analogues by aerobic microbial degradation. The paper by Rush et al. provides solid evidence that these processes can occur in oxygenated water columns and further that ladderanes have a relatively short-life time in sediments. The paper is well written and the data should be of considerable interest

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to readers of the journal. I recommend acceptance with minor changes.

1. Abstract, line 1. The term “trace” is vague. This first sentence should be rephrased so that it is more meaningful.

2. Line 9. The term “short chain ladderane lipids” should be defined here.

3. Line 14. It is not clear whether the pathway for beta-oxidation is inhibited or the organisms that carry out this process are not present or not viable in waters of very low oxygen content.

4. Page 2348; line 8. “caused” might be a better term than “led”.

5. Page 2350, line 20. The short-hand nomenclature used for ladderanes should be explained.

6. Page 2350, line 16. It might be better to say that “Concentrations of the unaltered ladderanes showed..”. Also, add “and at” before “relatively low”.

7. Page 2350. Some comment is needed to the effect that short-chain ladderanes have not been found as natural constituents in Planctomycetes, otherwise the whole discussion about them being degradation products could be negated. Since beta-oxidation is a common process could short-chain ladderanes actually be formed on cell death, perhaps through the activity of released enzymes? Similarly, the authors need to demonstrate whether it is possible that some might be formed as artifacts of the experimental procedures used to isolate ladderanes? I appreciate the fact that the authors mention that they can be lost using nitrogen blow-downs since this procedure is commonly used by organic geochemists.

8. Page 2352, line 15. “ladderane fatty acids”

9. Page 2354, section 4.1. The occurrence of short-chain ladderanes in the oxygenated upper water column, but absence in underlying oxygen-deficient waters, raises interesting questions as to how they might reach the sediment. The authors contend

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that most of the short-chain ladderanes in the sediment are produced in the water column, but clearly they don't accumulate in the oxygen-deficient waters due to transport from above so this suggests a fast transport through the water column, for example in zooplankton faecal pellets. It would be very instructive to see data on the occurrence of these compounds in sediment trap material, but unfortunately this isn't provided in this paper.

10. Page 2355, line 9. Can the authors rule out that the higher contents of short-chain ladderanes isn't simply due to higher fluxes from the water column when the deeper sediments were deposited? Other, more stable, biomarkers for Planctomycetes would be useful to distinguish between these various processes.

11. References. Careful editing is needed here. Check use of capital letters in titles, italics for species names, space after commas etc.. Use full name for Sinninghe Damsté in Hoefs reference. "Acta" rather than "Ac." in Geochim. Cosmochim. Ac.

12. Fig. 1. Label structures with carbon number. Note that production of the C14 ladderane from C18 requires two beta-oxidation steps. This begs the question as to why one doesn't see the C16 ladderane?

13. Fig. 4. The ladderane-inferred temperatures for the Arabian Sea seem to bear almost no relationship with the CTD-measured temperatures. To my mind, there is a strong need for a comprehensive discussion of the robustness of this temperature proxy. Does it really work and can it really be used as evidence for the water column origin of ladderanes found in underlying sediments?

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