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

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We thank Prof. Volkman for his positive comments on the manuscript. We will amend the minor (grammatical) comments in the revised manuscript. Below we address the reviewer's main comments:

3) A marine bacteria Alcanivorax strain has been shown to use this β-oxidation pathway. As this species is aerobic, it is unlikely that it would be present in anoxic waters. However, it is not impossible that a different facultative aerobe uses this pathway. We will amend the text to make this more clear. Currently, research is being done on microbial consortia at the NIOZ to investigate which microbes are degrading original C18-C20 ladderane fatty acids into short chain ladderane fatty acids.

7) Oxic degradation experiments ranging in temperatures from 10 – 100°C were shown in Rush et al. (2011). Maximum short chain ladderane production occurred at 40°C, indicating a microbially mediated process. Several environmental and biomass samples where anammox original ladderane fatty acids had been found showed no short chain ladderane fatty acids, which indicates that β-oxidation is not occurring upon anammox cell death, or that short chain ladderane fatty acids may be lab artifacts. The fact that short chain ladderane fatty acids are not found in the anoxic Cariaco basin demonstrates that molecular oxygen is needed for this degradation to proceed, in agreement with the fact that only aerobic bacteria have been shown to perform β-oxidation of fatty acids. 9) We agree that sediment trap material would be useful and in fact sediment traps were deployed during the Pelagia cruise which obtained the cores used in this study. However, due to the continuing political turmoil in the surrounding area (i.e. pirates off the coast of Northeast Africa), we have not been able to be recover these sediment traps.

We can only speculate that short chain ladderane fatty acids that are produced in the water column probably undergo the same transportation mechanisms as the original ladderane fatty acids, suggested previously by Kuypers et al. (2005) in other OMZ regions, i.e. aggregate formation and rapid sinking of particulate matter to the sea floor. In a previous study of the Arabian Sea (Jaeschke et al., 2007), original ladderane fatty acids were also only detected within the OMZ water column, presumably sinking quickly thereafter to the seafloor.

10) As we explain in the manuscript, at the depth interval 2 – 5 cmbsf, there was a lower ratio of short:original ladderane fatty acids (Fig. 6h). Also, the NL5 ratio, which indicates that the temperature at which ladderanes were produced, reflects the temperature of the Arabian Sea bottom water and not of the OMZ water column. Both of these point towards an in situ production. However, an increase in past fluxes and accumulation rates cannot be completely discounted, and we will amend the manuscript to include this alternative explanation.

12) Figure 1 will be amended as suggested. In a previous study (Rush et al., 2011), the C16 ladderane fatty acid with 3 cyclobutane rings was identified as a oxic degradation product. However, as this compound had also been found in low amounts in anammox biomass (Rattray et al., 2010), it was decided to exclude the C16 short chain ladderane. This is mentioned on page 2349 section 2.4

13) This is a valid remark, and has been discussed in a recent article in press (Rush et al., 2012) which focused on ladderane fatty acids in the Eastern Tropical North Pacific. There, it was found that C18 ladderane fatty acids were dominant over C20 ladderane fatty acids ($\sim$5x more abundant) which led to no correlation between the NL5 temperature and the measured in situ temperature. However, in settings where there is no dominance of either the C20 or the C18 ladderanes, the NL5 index appears to be related the growth temperature of the anammox bacteria. In the Arabian Sea, C18 and C20 ladderanes are within the same order of magnitude, and we believe that the average NL5 calculated temperature in the water column correlates well with the average CTD measured temperature of the OMZ. Nevertheless, we will add some more cautionary words on the use of NL5.

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