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Biogeosciences
Discussions

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

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The manuscript by Rush et al. presents environmental data of ladderanes and their oxidation products from some marine settings (water column and sediments) in which short chain ladderanes (SCLs) are found in much higher amounts than their original counterparts. The SCLs are assumed to represent degradation products produced by beta-oxidation of the original elongated ones. Evidence comes the finding of those in environments below an active anammox zone, either water column or sediment. The readership of Biogeosciences would be suited for such kind of topic.

However, I have some concerns regarding the submitted manuscript that should be taken care of in a final version. The authors should specifically provide some clear evidence that SCLs are not formed de novo since some cultured relatives have been found



to contain those, maybe due to environmental adaptation or dependent on species. This should be part of the discussion. I also miss information about the internal variations of the SCLs. This would bring in additional information about production and degradation of the SLCs. Is one product, the end product maybe, dominantly formed? Different SCLs may react at different rates. Moreover, I suggest deleting parts related to the NL5 index from the water column. In respect to NL5 and sediments, I recommend to discuss the validation of the proxy dependent on eventual changes caused by the degradation in a dedicated section. Thus, I recommend publication with moderate changes.

Specific comments:

Page 2344, Line 20: I believe the trend of increasing abundance of SCLs, but is it possible that the number of 90% is biased by storage of the extract of Arabian sediments at 4°C?

Page 2345, Lines 1 and 2: A time marker for how long we can trace back the signal should be given here. The group of authors found already ladderane lipids in samples as old as 140 kyrs (Jaeschke et al., 2009).

Page 2346, Study sites and sampling methods: For some samples, number and exact depths of samples are given (Arabian Sea) but no details are provided for the other sites, specifically Peru Margin. Please add that information. It would be also interesting to know how the samples were stored after recovery since degradation of ladderanes is the main topic of the paper here.

Page 2348, Line 22: Why were Arabian sediments stored at 4°C instead of -20°C? I assume that there was an oxygen head space. Does this induce oxic degradation of ladderanes? May this explain the high abundance of SCLs in the Arabian sediments? Please explain.

Page 2349, Lines 17-21: Why should 14[5] and 14[3] not be produced as such if 16[3]

has been detected in an enrichment culture? Other unidentified anammox bacteria may produce them de novo. Give some statements here or later. Additionally, information about the internal variations of SCLs would be of good value because I assume a relative increase of 14[3] and 14[5] with time and elongated oxygen exposure.

Page 2350, Line 10: Please take more care here. The NL5 formula is incorrectly displayed. Generally, I asked the question if NL5 data are needed for this publication. If yes, the authors should provide a dedicated section that is related to the validation of this proxy, especially in the sediments.

Page 2350, section 3.1.: Please also refer to Figs 3a and b in the Text.

Page 2351, Lines 7-9: Why do anammox bacteria respond to the average temperature of the OMZ? Are they drifting up and down? If they are produced in situ ladderane-derived temperature estimates should reflect these as well. If stated like this, the reader needs more background here or later.

Page 2355, Lines 7-9: The statement that SCLs are only predominantly the result of oxidation implies another formation pathway. This could be in situ production.

Page 2355, Lines 9-13: Why is the in situ signal of ladderanes, including original ones and especially SCLs, that quickly removed from the sediment? All other sediments show a persistence of the SCLs with depth which would mean they are pretty stable against degradation. Who is degrading the signal? Is preservation by adsorption to the sediment matrix, as stated later for Peru Margin sediments, a possible explanation here?

Page 2355, Lines 17-20: How deep is oxygen penetrating into the sediment? Any information about that would be of benefit. Otherwise this is weak statement. If oxygen is depleted rapidly, I would assume anammox being active in the sediment. It would be at shallower depth than at station 10 where higher oxygen is around. If the authors intend such a process in lines 23-27, I would suggest rewriting in order for better clarification



of the reader.

Page 2356, Lines 23-25: Does the absence of matrix-bound ladderane lipids not simply indicate the absence or very low activity of anammox at the time of sediment deposition at the Peru Margin below a certain sediment depth?

Page 2357, Lines 11-13: Please rephrase this sentence. There is no real trend of decreasing SCLs with time. Concentrations of SCLs at station 1 are even higher in the sediments than original ladderanes in the water column (Figure 3c) or the top sediments (Figure 6a). That is why the authors cannot provide a correlation for this station in Figure 8d. How can such a finding be best explained? In situ production? Sediment remobilization? Likewise results are shown from the Peru Margin (Figure 7). Unfortunately, water column data are not presented.

Page 2358, Lines 9-11: Can the authors provide an explanation for the discrepancy relative to the Jaeschke et al. result? It is from a very similar location.

Page 2358, Lines 24-26: As stated above, there may be no anammox present before that time boundary.

Page 2359, Line 2: Please rephrase to “SCL fatty acids are dominantly formed by. . .”.

Table 1: The authors should give some information which sediment depths or at least how frequent the sediments were sampled (i.e. every 20 cm or so).

Figure 1: It would be of help when the authors show the presumed degradation pathway from one ladderane lipid to the other (simple arrows?). However, I assume that the degradation of 18[5] to 14[5] goes along via 16[5]. Why is this compound not detected? 16[3] and 14[3] from 18[3] are seen simultaneously. Is this because of a different oxic degradation pathway? Double beta-oxidation?

Figure 2: I recommend to remove this Figure. It is not a global data set that we deal with here. Secondly, the inserts are not needed since both give no more detailed information as does Figure 5.

Figure 4: Please add chemistry data (O2, NH4+ etc.), if available, as provided for the Cariaco Basin. The relative abundance of SCLs does not need to be displayed. Just provide numbers in the text. Why is the NL5 temperature profile constant and the CTD temp not? This non existing relationship implies that the proxy application is nor straightforward or even valid. Can the authors come up with an explanation? I recommend removing of NL5 data and combining the T data with the ladderane concentrations.

Figure 7: What is the relative abundance of all FA? Are only ladderanes meant here or all FA, including 16:1 and 16:0 and so forth? Please clarify.

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Interactive comment on Biogeosciences Discuss., 9, 2343, 2012.