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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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In this study, the authors aim to further explore the uses and limitations of ladderane lipids as biomarkers for anammox bacteria in the environment. Previous work has shown the presence of ladderane fatty acids in sediment and water column oxygen minimum zones (OMZs) where anammox activity has been detected. A more recent laboratory study showed that oxic degradation of ladderane lipids resulted in the production of short-chain ladderane fatty acids, but little was known of the occurrence of these oxidation products in the environment or of their potential use as a tracer for past anammox activity. In this study, the authors analyzed sediment and water column particulate samples from three different oceanic environments (the OMZs of the Arabian Sea and the Peru Margin, the euxinic Cariaco Basin) for the presence of the original

ladderane fatty acids and the short-chain oxidation products. In terms of production of short-chain fatty acids, they concluded that beta-oxidation of the original fatty acids occurred in low oxygen (<3uM), but not anoxic, settings, and that most of the short-chain fatty acids were produced in the water column rather than the sediments. In terms of preservation potential of the ladderane fatty acids, they found that degradation of short-chain ladderane fatty acids was slower than the original ladderane fatty acids, potentially because some short-chain fatty acids became bound to the sediment matrix thereby aiding in the preservation of those lipids. Overall, the authors suggest that the short-chain ladderane fatty acids may be suitable biomarkers for anammox activity in late Quaternary sediments from below OMZs.

I feel that the paper does indeed advance our knowledge of the use of ladderane lipids as biomarkers for anammox bacteria in the environment, particularly as a potential tracer for past anammox activity in marine sediments. The authors chose an appropriate set of sites, which included water column particulate and sediment (both surface and deeper) samples, and they supported their ladderane lipid data with ancillary (i.e. oxygen, nutrient, temprature) data when appropriate. I am comfortable with their conclusions and support publication of this manuscript with minor edits, as detailed below.

Specific Comments (page, line numbers given)

p. 2345, line 5 Insert "select" between "by" and "Planctomycetes" to make clear that not all Planctomycetes perform anammox.

p. 2345, line 25 You focus on oxic biodegradation products in this study. Did you find evidence for anoxic biodegradation products in your previous work? You mention later in this paper that further degradation occurs (with depth) in anoxic sediments, which suggests that some sort of anoxic degradation pathway exists.

p. 2347, line 12 Do you mention H2S concentrations because it interferes with the anammox reaction?

p. 2351, lines 7-9 Do you have reason to believe that anammox bacteria in the OMZ were exposed to the “average” temperature of the OMZ rather than a more stable temperature at a specific depth? I do not understand why the NL5 temperature data does not correlate better with in situ temperature. Perhaps this is not a robust proxy for temperature in the environment.

p. 2353, line 6 You detected significant ladderane fatty acids in the residue left after the Bligh-Dyer extraction of Peru Margin sediments. What does this mean for your Arabian Sea sediments, for which you only analyzed the TLEs for ladderane lipids? How important is it to consider both the matrix-bound and freely-extractable fractions for future studies?

p. 2354, line 9-15 I am more willing to accept that the NL5 value in the sediments can represent the “average” OMZ temperature because it is derived from a lipid signal that is a composite of particulate material likely produced at various depths (and temperatures) within the OMZ that have sedimented over time. I still do not think the NL5 values from the water column SPM, collected at discreet depths, make sense (see my comment above).

page 2355 For station 10, how can you rule out changes over time in the flux of anammox lipids to the sea floor, which you suggest might have occurred at station 4?

page 2356, lines 12-13 Can you expand your discussion on potential anaerobic degradation pathways (from your own work or others)? Do you know what the potential degradation products might be (i.e. other short-chain ladderane fatty acids)?

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