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Biogeosciences Discussions

Interactive comment on "Predominance of hexamethylated 6-methyl branched glycerol dialkyl glycerol tetraethers in the Mariana Trench: Source and environmental implication" *by* Wenjie Xiao et al.

Anonymous Referee #1

Received and published: 31 October 2019

The manuscript by Xiao et al. presents a very interesting and welcome dataset on the distribution of brGDGTs in the Mariana Trench sediments. The results show distinct predominance of hexamethylated 6-methyl brGDGTs in this deepest ocean, suggesting brGDGTs are produced in situ by indigenous bacteria. This provides new insights into the composition of brGDGTs in "uncontaminated" marine and its usefulness as an endmember for brGDGTs source trace. It is suitable for Biogeosciences, but I have some suggestions/comments that could possibly improve the manuscript.

General Comments:

1. The current introduction dwells heavily on the history of brGDGTs, addressing their application as biomarkers for paleoclimate reconstruction, but falls short on giving much insight into the microbial ecology of this mysterious marine system. Oxygen concentration almost certainly plays a strong role in structuring the GDGT-producing microbial communities. Most brGDGTs were found produced by anaerobic bacteria. I strongly recommend the authors devote more space in the manuscript to discussing their data in the hydrologic and biogeochemical context of the MT.

2. I think that the paper would benefit from less discussion about the global brGDGT index application, which was already deeply discussed in Xiao et al. (2016). It dilutes the main conclusion of the paper, which is the distinct predominance of hexamethylated 6-methyl brGDGTs but also the absence of 5-methyl brGDGTs in the deepest ocean, this is an exciting result and again I hope the authors could devote more space on the explanations. Although some papers have already reported the dominance of hexamethylate brGDGTs in the marine sediments, none of them found the absence of 5-methyl brGDGTs. To me, it should be mainly driven by specific producers in this extreme environment than the environmental condition changes.

3. The application of soil pH index CBT' and mean annual air temperature index MATmr in this marine setting is unconvincing. To be noticed, both CBT' and MATmr were established using stepwise forward selection, see De jonge et al. (2014) and Loomis et al. (2012), which are only suitable for terrestrial regions and have no mechanism behind compare to CBT/IBT or MBT.

4. Results and discussion not completely separated There is some overlap here, with data appearing in the discussion.

5. The cross plot of acyclic hexa-/pentamethylated brGDGTs ratio and fractional abundance of brGDGT-IIIa' as a new approach to distinguish the terrestrial vs. marine provenance of brGDGTs (Fig. 10) can be removed. As the relationship between the (IIIa+IIIa')/(IIa+IIa') index and the BIT index (Fig. 6; Xiao et al., 2016) have already

clearly separated the Mariana Trench sediments from the other samples. I think that it could be eliminated with no loss to the manuscript (If it remains, its value should be made more clear, why it's important compare to the index set before).

6. There is an excessive number of figures, leading to some redundancy. I would delete some overlapping ones and focus more on the main point (see specific points of clarification below).

Specific comments:

Line 15: Leave space between numbers and symbols, keep consistent format for the left manuscript. Keep one decimal place for the relative abundance of brGDGTs for the following parts.

Line 22-24: See my general comments

Line 36: Change the literature order in the reference. The early shown one should be named Weijers et al. (2007a)

Line 43-45: One sentence missing: While isoGDGTs were mainly produced in the marine realm. Thus. . .

Line 57: Schouten et al. (2007) is misused here.

Line 60: brGDGTs with cyclopentanes are not called hexa- or pentamethylated brGDGTs. Please correct this sentence.

Line 111: Please cite Huguet et al. (2006) here.

Line 112: (3:1, v/v)

Line 122: Italic m/z, correct followings.

Line 195:A description of HPLC/MS method in the Method Section is missing. Either add in or cite a paper. If this is not a method developed by the authors, please rephrase the sentence.

Line 197: ". . .and hexamethylated (m/z 1050) brGDGTs in sediments of the Mariana Trench. This feature shows a distinct difference. . ."

Line 248-253: This part should go to results.

Line 242-263: As the authors mentioned two times in both introduction and method, this deepest trench is remote from any mainland and has no significant terrestrial influence. Either shorten it using one or two sentences or delete it.

Line 264: . . .is similar to those of distal marine sediments. . . Schouten et al. (2013) is not a good reference the way it is written here.

Line 266: Recheck the numbers you used here. 1354 soils and 589 marine sediments should be.

Line 272-278: see my general comments

Section 4.2: Would it be nice to add in the data of this study for comparison, since all of the data the authors choose are sea sediments.

Line 333-336: Again results.

Line 341-346: This is more a comparison of the indexes than the discussion of mechanisms behind. I would suggest to delete it. Only talking about the reasons for the predominance of IIIa' here, 1) sedimentary in-situ brGDGTs-producers produce more hexamethylated brGDGTs to adapt to the low temperature/poor nutrient conditions (Sinninghe Damsté, 2016; Ding et al., 2018); 2) brGDGTs-producers adopt a strategy of the carbon skeleton isomerization of brGDGTs to live at alkaline seawater, resulting in a distribution in which 6-methyl brGDGTs are abundant (Ding et al., 2015; Xiao et al., 2015).

Line 349-372: See my general comments, I would condense this part and delete the discussion that dilutes the main findings.

Line 435: Recheck the format of references. Some doi can not be opened.

Fig. 2: Set a boundary between brGDGTs from Crenarchaeol, most external readers will not understand.

Fig. 7: Not needed, see the general comments above

Fig. 9: Delete Fig. b, c and d since they are showing the same results as a.

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