

Interactive comment on “Ubiquitous production of branched glycerol dialkyl glycerol tetraethers (brGDGTs) in global marine environments: a new source indicator for brGDGTs” by Wenjie Xiao et al.

Anonymous Referee #1

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Review of the manuscript “Ubiquitous production of branched glycerol dialkyl glycerol tetraethers (brGDGTs) in global marine environments: a new source indicator for brGDGTs”, by Xiao and co-authors.

The authors present an interesting manuscript, based on an extensive dataset compiled from previous publications. The figures are well chosen and convey the message clearly. The IIIa/IIa ratio can be used to identify those sediments that are characterized by a dominant marine production of brGDGTs. This ratio can complement the BIT index, and has the added feature that the degradation of marine-sourced IIIa vs IIa is

C1

expected to happen to the same extent (while crenarchaeol has a more different chemical structure and possibly a different source organism and thus a different degradation potential).

The implication and possible use this ratio has for tracing soil OM transport is exemplified and convincing. However, for palaeoenvironmental reconstructions, there is no guideline on how to deal with sediments with ‘mixed signals’. Here, discussing the compounds separately can help, as it will point the authors towards which proxies can and can’t be used in the case of in-situ production of brGDGTs

Main comments (short, they are elaborated on below).

It is interesting that the IIIa/IIa ratio increase significantly in offshore marine sediments. However, the authors have not attempted to explain this by comparing the compounds this ratio is composed of (IIIa, IIIa’, IIa or IIa’). This lessens the value of this study, by narrowing its implication for palaeoenvironmental studies. In the Kara Sea (Arctic Ocean) De Jonge et al. (2016) have clearly shown that brGDGT IIIa’ increases in increasingly marine conditions (Yenisei River outflow), while brGDGT IIa’ does not. The Iberian Sea (Sinninghe Damste et al., shows a different pattern). If the authors can shed light on which mechanism acts on marine sediments globally, this has implications for which temperature proxies can be used (also see De Jonge et al. (2016)).

I find the reasoning behind the absence of a temperature difference between soil/peat and marine brGDGTs incomplete. I expect a very large difference in temperature between soil and marine bottom water, even at similar latitudes.

The introduction of previous studies describing marine in-situ produced brGDGTs is too concise. Furthermore, in the discussion I miss how the conclusions from the authors fit with previously published manuscripts? Can we say anything about the water depths at which brGDGTs are produced?

Minor comments:

C2

L14. Rephrase this so the “presumed source” of brGDGTs (soil, peat) is introduced first.

L33: Use ‘have been’ instead of ‘have become’.

L43: Rephrase, this is a confusing sentence. The stereoconfiguration of the glycerol moiety indicates that they are produced by bacteria, not the fact that they are abundant in soils.

L49: Please include that 15 brGDGT compounds are generally encountered in soils. Besides the variation in the number of methyl groups and cyclopentane moieties, the location of the outer branches has been shown to shift as well.

L 54: Use Thaumarchaeota instead of crenarchaea.

L 58: Here, you can also refer to ‘Weijers et al. (2014), Constraints on the sources of branched tetraether membrane lipids in distal marine sediments, OG 72’.

L 87-90. As this manuscript discusses brGDGTs produced in marine systems, I would expand a bit more on all studies that have provided evidence for the in-situ production of brGDGTs in the marine environment (instead of just listing them up). Now, only the recent Sinninghe Damste (2016) paper is introduced.

L 91-99 could be restructured, they are not easy to understand.

L 106: ‘the marine carbon cycle’

L 112. ‘the mean depth is’ and ‘the Bohai Strait, at the east’.

L 114: ‘the second largest river in the world, concerning sediment load (+reference)’

L 115: ‘One gravity core of 64 cm was...’

L 118: respectively can be removed here.

L 125: If this extraction and separation protocol has been described elsewhere, you can simply refer to this original publication. The same goes for the analysis of the

C3

GDGTs on the LC system.

L 183: This can be rewritten as: De Jonge et al., 2015, 2016.

L 206: Can the authors not give an indication at which BIT values (both on the local and global scale) the proportion of marine brGDGT becomes problematic? This would be useful from the viewpoint of palaeoclimate reconstructions.

L 235-237: Is a repetition of the L 237-242.

L 282. It surprises me that the authors indicate here that Crenarchaeota/Thaumarchaeota are the probable producers of marine brGDGTs. Is there any indication that this would be the case? Alternatively, I would remove this statement.

L 303. The argument that continental and marine temperatures are significantly different is put aside much too quickly. Indeed, they are both globally distributed, but the temperature of your water bodies will be much more stable throughout the year (which has an implication of the production temp as soil-derived brGDGTs are thought to be produced mainly in spring-autumn, especially at sites that are partially frozen throughout the year. Furthermore, if marine brGDGTs are produced at the sediment/water interface, this will of course be much colder than the sea surface temperature.

Taking this into account, I doubt that the authors will be able to make a strong case on their proposed absence of a temperature difference between soil and marine brGDGTs.

L 304. If the authors want to discuss this trend between soil pH and III/II, they have to provide a plot. Does this trend also apply for more extreme pH values? Can it be strengthened by determining which compound causes this trend (IIa, IIa', IIIa, IIIa')?

L 308: The pH of marine water is indeed fairly stable, but it can be very different in pore waters in the sediments. This should be mentioned.

L 367: ‘and a compilation of’

L 364-367: I do not agree that the authors have enough evidence and data on this to make this conclusion.

References: please check the manuscripts guidelines. Journal names are to be abbreviated.

General: In the manuscript text, the authors should pay attention to the order of references. Older references should come first.

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