

## ***Interactive comment on “Source, transport and fate of soil organic matter inferred from microbial biomarker lipids on the East Siberian Arctic Shelf” by Juliane Bischoff et al.***

### **Anonymous Referee #2**

Received and published: 7 June 2016

This is a review of the paper “Source, transport and fate of soil organic matter inferred from microbial biomarker lipids on the East Siberian Arctic Shelf”, by Juliane Bisschof and co-authors, submitted to Biogeosciences as a discussion paper. I have based my review on a paper print version of the manuscript.

The paper is well-written and very well referenced. It discusses an extensive dataset of surface sediments in the East Siberian Arctic, a region that is of interest because of its sensitivity of carbon export in response to past and predicted temperature increase. This dataset is complemented by a number of terrigenous samples.

The results and discussion show that the distribution of bacteriohopanepolyols, expressed as the R<sub>soil</sub>, can be used to trace the outflow of terrigenous organic carbon.

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It mimicks the stable isotopic signal of the sedimentary organic carbon, which has been used globally to trace terrigenous/marine source of organic matter in riverine outflow systems.

The discussion is centered around two observations: the offset between the BIT and R<sub>soil</sub> values, and the east-west gradient in R<sub>soil</sub> values in permafrost from west to east.

In the first part of the discussion, I miss a few approaches that would make the discussion more complete. Both the BIT index and R<sub>soil</sub> index are determined both by a decrease/increase in terrigenous vs. marine lipids. To compare changes in the degradation of the terrigenous compounds, it is necessary to compare the concentration of these compounds (and possibly also contrasting the different terrigenous BHPs, do they follow the same trend?), rather than comparing the ratios (as these can be influenced by the marine end-member as well).

The offset between brGDGT and BHP behavior is entirely attributed to different spatial distribution of the sources by the authors. The R<sub>soil</sub> is proposed to represent a more integrated signature of differential terrigenous sources, including ICD organic matter. However, brGDGTs have been shown to be present in ICD in this study, and in De Jonge et al. (2016). Erosion of ICD OM would thus result in the introduction of both terrigenous GDGT and BHP in the marine environment.

It is also possible that the lipids and bulk parameter represent different pools of OM within the permafrost soils. As mentioned in the manuscript, the lability of the OM depends on the age and organo-mineral interactions. If brGDGTs are more labile to degradation, with BHPs more protected, and bulk OM having the same age/organomineral interaction as the BHPs, this can explain the observed offset. Can the authors hypothesize on this? Is there an indication that soil-marker BHPs are preferentially present in older, pre-aged soils, with brGDGTs more abundant in more recently produced material? Can the authors speculate about the size of the particles that BHPs

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vs brGDGTs are transported on? Can the study by Tesi et al. (2016) help to explain the observed patterns?

The second part of the discussion, where the increase in permafrost R<sub>soil</sub> values is observed in permafrost from west to east, is extensive. Is this shift however also observed in the marine sedimentary R<sub>soil</sub> values? It does not seem to be the case based on the mean values, but perhaps the R<sub>soil</sub> values in the samples closest to the river mouths follow an east-west trend. If no such a trend is present, the discussion at lines 4-14 (page 12, printed version) is less relevant, as this discusses a trend in properties of sedimentary compounds.

How can the different formation mechanisms for ICD explain the observed east-west gradient in BHP composition? (see fi. L. Schirrmeister, et al., Sedimentary characteristics and origin of the Late Pleistocene Ice Complex on north-east Siberian Arctic coastal lowlands and islands – A review, Quaternary International, Volume 241, Issues 1–2, 2011, Pages 3-25.

Can the authors include the continental OM studied in the title? Fi: "...on the East Siberian Arctic Continent and Shelf".

I have a number of minor corrections below: L5P2, use pool instead of store.

L10P2, have instead of cause

L16P2, Is there a more recent reference for increasing water discharge to the Arctic Ocean?

L31P2, remove 'that'

L6P3, rephrase as 'acting as a positive feedback for climate warming'

L15P3, include 'marine' before crenarchaeol

L24P4, rephrase as: 'with recently published BIT data'

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L34P4, refer to the Fig. 1 when discussing the study site

L10P5. Perhaps the zones can be circled in Fig. 1?

L4P7. Perhaps the authors can also summarize the stable isotopic values here?

L25P8. How does the TOC-normalized concentration of aminotetrol and –pentol compare with the values reported in De Jonge et al.(2016)? Can their relative abundance perhaps say something about a terrigenous vs marine source?

L24P10. The BIT values can be significantly different between laboratories, so you have to be careful when comparing values between different studies. See Schouten et al. (2013) An interlaboratory study of TEX86 and BIT analysis of sediments, extracts, and standard mixtures. *Geochem. Geophys. Geosyst.* 14, 5263–5285.

L7P11. Can the authors include in their discussion whether the relative abundance of the 3 soil-marker BHPs separately is comparable between ICD settings, but also with marine sediments? Does this support an ‘unchanged’ terrigenous signal to the marine environment (as stated at L30-35P11).

L22P12. What is the pH range studied in the Hofle et al. (2015) paper? Is this pH range relevant for this manuscript?

L5P13: I recommend to use the term ‘terrigenous’, instead of ‘terrestrial’.

L10P15. The journal name is abbreviated.

L29P16. Vol is mentioned twice

L33P16. n/a in the reference should be changed to manuscript number.

L5P18: Journal name is abbreviated

L9P19: subscript in CO<sub>2</sub> and CH<sub>4</sub>.

L22P19: replace n/a

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L33P20: replace n/a

L35P20: If this is a book, please include the publisher.

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