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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 #1

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REVIEW COMMENTS

Bischoff et al. present BHP data from samples in the East Siberian Arctic Shelf and adjacent continent to characterize the source and transport of permafrost microbial organic carbon in the high Arctic. The authors compare BHP inventories (BHP abundances and the R'soil proxy) with previously published BIT indices and bulk δ13C data from the same samples. The manuscript focuses a lot on the findings of other studies (e.g. section 3.3) and would benefit from offering additional perspectives to understand the different signals carried by the investigated proxies. For example, the fate of the terrestrial permafrost-derived bacterial OC in the ESAS is still largely unclear and the physico-chemical processes shaping the proxy signals remain under-explored.

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Discussion paper

The authors conclude that BIT and R'soil represent "different aspects of terrestrial OC" (p. 9, l. 29) and attribute the non-linear correlation of BIT and R'soil to different permafrost sources and transport modes. Based on the large spread of R'soil values in permafrost deposits (see Table 1), however, it is very difficult to assign endmembers. Permafrost soils and ICDs carry extremely heterogeneous BHP/R'soil signatures even within small spatial scales (see Table 1; ICD R'soil 0.37-0.64 for KUR core, soil R'soil 0.18-0.79 for Lena Delta active layer soils – maybe the authors can offer insights as to which factors control the proxy values? For example, do R'soil values show a depth trend in permafrost?). Accordingly, how representative are the mean values for these two endmembers and how can they truly be distinguished? The discussion should be extended to include a dedicated paragraph on this heterogeneity and potential biases arising from it. The heterogeneity should also be considered when discussing W-E trends along the ESAS. Also, the rationale behind the conclusion that the R'soil index carries a more integrated signal of terrestrial OC sources (p. 9, l. 26) including ICDs and riverine BHPs while brGDGTs are only exported fluvially is unclear. Why should the brGDGT inventory of ICDs eroded via coastal erosion not contribute to the sediments while the BHP inventory does? Also, how can the biomarker inventory from ICDs eroded by coastal erosion on the ESAS be distinguished from the biomarker inventory eroded from ICDs further upstream – such as Kurungnakh and other Yedoma delta islands – which is categorized as fluvial OC? These endmembers and potential mixing scenarios should be discussed in more detail in the manuscript. Furthermore, when comparing the proxy-derived pattern of terrestrial OC supply to the ESAS, the authors only discuss potential influences of the continuous vs. discontinuous permafrost catchment coverage. While the Lena catchment also includes discontinuous permafrost areas, these amount to only 20% located entirely in the upstream area. Accordingly, all terrestrial samples investigated in this study derive from continuous permafrost deposits and the change of their R'soil values cannot directly be linked to permafrost conditions. How do/might other factors such as catchment size, runoff, or sediment/POC load shape the proxy signal(s) in the ESAS?

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SPECIFIC COMMENTS p. 2, l. 31: replace “that” by “the OC” p. 3, l. 6: correct “reminder” to “remainder” p. 4, l. 1-2: sentence is somewhat repetitive p. 4, l. 3: change “setting” to “settings” p. 4, l. 15-17: add some background to the work of Dogrul-Selver et al., so the sentence better connects with the previous sentence referring to the GDGT and δ13C study of Sparkes et al. p. 4, l. 24: emphasize that these the exact same samples used by Sparkes et al. p. 5, l. 13: add "the central Lena Delta“; p. 5, l. 19: change capital letter “The” to “the” p. 6, l. 10: were the 1/3 TLE splits (as described in the previous paragraphs; p. 5, l. 32 and p. 6, l. 8) further split into 1/6 and 1/3 fractions? p. 6, l. 14: either use “N2” (p. 6, l. 8) or “nitrogen” consistently p. 6, l. 25: change “concentration” to “concentrations” p. 6, l. 29: change “than” to “that” p. 7, l. 3-4: re-write sentence p. 7, l. 5: change “Concentrations” to “concentrations” p. 7, l. 7: add “their BHP composition” p. 7, l. 10: see comment to Figure 2 (below) p. 7, l. 14: add “in all other nearshore settings” p. 7, l. 18: add “the BHT isomer” p. 8, l. 12: for better comparison add the average percentage of NM soil markers in the Congo estuary p. 8, l. 22: the sentence should rather refer to the general concept of export from terrestrial systems into marine systems; it currently gives the impression that this is only applicable to the Congo deep sea fan. p. 8, l. 23-28: the likelihood of amino-BHP export from wetlands vs. in situ production in sub-sea permafrost could be assessed in more detail. Especially for the Buor Khaya Bay, the amino-BHP concentrations found in the permafrost core from Kurungnakh (this study) and from other studies within the Lena Delta (e.g. Höfle et al., 2015) should allow making better constraints. p. 9, l. 7: change “Eastern” to “eastern” p. 9, l. 15: delete “did” p. 10, l. 6: change “Eastern” to “eastern” p. 10, l. 26: specify “this region” p. 11, l. 12: “Although additional sources from fluvial transport and from material transported via changes in hydrological conduits resulting from thermokarst erosion are also possible” – what type of material is referred to? POC? p. 11, l. 15-16: the Samoylov and Kurungnakh deposits are also genetically different (Holocene fluvial sediment vs. Pleistocene ice complex; Schirrmeister et al., 2011), which is likely mirrored in bulk δ13C values. p. 11, l. 15-22: δ13C values should be rounded to one digit p. 11, l. 22: delete “de-

rived" p. 11, l. 15-27: what is the conclusion from this paragraph? p. 11, l. 33-34: add the uncertainty of the % estimate (75±17% and 63±14%) given the large spread of R'soil values in the Kolyma and Indigirka ICDs. Also, these estimates should not refer to OC in total, but only the BHP pool. Other lipid biomarkers or even non-lipid compounds will likely give a very different picture. p. 12, l. 2-3: the estimates of ICD contributions in the ESAS differ largely if the riverine OC is included in the mass balance; for Buor Khaya Bay sediments, Vonk et al. estimate ICD contributions at >50% while Winterfeld et al. (2015; doi:10.5194/bg-12-3769-2015) estimate the ICD contribution to POM around 10%. These differences should be considered. p. 12, l. 4-16: again, considering the large spread of R'soil values within the permafrost samples from each area, and the very limited amount of samples from some areas investigated here (Cape Bykovsky, Kolyma, Indigirka), the trend of increasing R'soil values from W to E is somewhat disputable. Thus, inferences made about the recalcitrance of certain BHPs should be discussed very cautiously. Also, organo-mineral associations seem to be of minor importance in the polygonal tundra (Höfle et al., 2013; doi:10.5194/bg-10-3145-2013) strengthening the argument that the abundance of adenosylhopane and related compounds may as well simply represent a metabolic response to the environmental conditions restricting further side chain elongation (given adenosylhopane is an intermediate in BHP side chain synthesis; Bradley et al., 2010). Figure 1 caption: add "the ISSS 08 expedition"; move brackets for Lantuit et al. citation; Change "KY" to "KI = Kurungnakh Island" Figure 2: panels do not have letters as assigned in the caption and the order seems wrong – panels 1 and 2 should be reversed. Figure 4: Since Figure 4 is referred to in the text when discussing average R'soil indices, it would be helpful to add the mean value contour lines of each group. Figure 5 caption: last sentence – add "in the Lena River region"; specify "eastern region"; add description for abbreviations used (such as PF and superscript a) Table S2: add header to columns K-Z (BHP concentrations)

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