

Interactive comment on “Carbon sources in the Beaufort Sea revealed by molecular lipid biomarkers and compound specific isotope analysis” by I. Tolosa et al.

Anonymous Referee #1

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Review of Tolosa et al. Carbon sources in the Beaufort Sea revealed by molecular lipid biomarkers and compound-specific isotope analysis.

The manuscript by Tolosa et al. provides a large dataset of biomarker concentrations and compound-specific stable carbon isotope data from suspended matter and surface sediment samples in the Mackenzie Shelf and slope as well as from the Mackenzie River. While not the first such study in this area, the amount of new data collected is significant and the full data are provided which is useful for further studies and data comparison. The data collection and analytical work looks solid, and while I see a publishable dataset I find the manuscript in its current version needs some work. The

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discussion is quite difficult to follow (jumps back and forth – though it's not an easy task to improve this given the complexity of the dataset), and there is room for a more critical interpretation of the data, and to put some more emphasis on the main new findings emerging from this particular study (go beyond the descriptive). I have detailed some suggestions and comments below.

The approach of assigning source contributions taken by the authors have some limitations. While obviously the compound-specific data can be used to obtain more detailed information than bulk measurements ($\delta^{13}\text{C}$ and $\delta^{14}\text{C}$ – due to overlap in signatures and a limited number of proxies), using the compound information to constrain contributions is complicated by the different degradability of different (groups of) compounds, and by their relative concentrations in each of the sources. This is not taken into account in this study. While the authors admit that their approach is only semi-quantitative (P 13945 L 15-20), I think this requires some extra effort. In particular, it is somewhat misleading to express results such as “we estimated that the fraction of terrestrial material preserved in the sediments accounted for 30–40% of the total carbon in the inner shelf sediments, 17% in the outer shelf and Amundsen Gulf and up to 25% in the slope sediments.”

Also, given that only surface sediments (upper 5 mm !) were sampled, the contribution of some sources will be overestimated given that further diagenesis is likely to occur for more labile compounds/markers. This makes it very difficult to compare the estimated contributions in this paper to earlier estimates, and might be the reason why for example, the fossil component is estimated to contribute so much in the current study compared to earlier results based on bulk measurements. A more critical discussion of these limitations seems warranted, in the intro (page 13928 L15-20) and in the Discussion. At the moment, results expressed as a relative contribution of a pool of biomarkers is a little weak.

The abstract should stress the fact that only surface sediments were sampled (in contrast to earlier studies?)

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Page 13927 L17: specify for which area this production rate relates to.

Materials and methods: should describe how the CO₂ aq data in Table 2 were obtained. Dito for nutrient concentrations etc. reported in Table 2.

P13932 L15-16: specify if data from peaks lower than 0.5V are also included (or omitted) and if included, provide arguments against a possible bias in the d¹³C data

P13933 L9-11: could this pattern also result from a mixture of different components with contrasting n-alkane patterns ?

Results on sterol composition: unless I missed something it seems that no brassicasterol was detected, correct ? Is this not unexpected given the contribution of diatoms mentioned elsewhere ?

P 13938 L12: alkanine : should be alkaline

P 13938 L15: provide a reference here for the C₃ range of n-alkanes (eg. Papers by F. Rommerskirchen etc). The numbers cited seem somewhat on the high side ?

P 13938 L20 "sea ice proxy": be specific: marker for sea ice algae

P 13939 L13: provide a reference supporting the specificity of this marker.

P 13940 L6-9: Should look not only at d¹³C signatures of the markers, but also their relative concentrations in the sources may differ – so d¹³C in the "mixture" may be biased towards one source if it has higher concentrations.

P 13940 L11-14: mention d¹³C values for the LCFA's here. Can these learn us something on the relative contribution of higher/lower plants (trees vs. mosses etc)

Statement on P13941 L4-6 is overall not very well argued.

Page 13942 L5: more enriched than ?

Page 13942 L20: a bulk value of -28 per mil would still not result in values as low as -42.5 per mil in biomarkers ? Or provide literature data on Dd values for relevant
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markers to demonstrate that such large shifts are reasonable.

Page 13947 L 6: 24 per mil: -24 per mil

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