

We would like to thank the Editor and both reviewers for the time devoted on our manuscript and their valuable comments. We provide a point-by-point reply below or next to each comment in green.

Anonymous Referee #1

Specific comments:

Line 116: Table 1. the cores are in very different water depths, can you acknowledge that somewhere in the discussion, especially knowing that many deep-time paleotemperature and -productivity records come from open ocean deep-sea sediments. *Added in line 399-400.*

Line 127: for the quantification, what standard and at what concentration was used? Did you run replicates? *Concentrations were quantified using *n*-hexatriacontane as external standard. Analytical precision of Uk'37 was better than 0.003 units based on repeated measurements of an in-house alkenone standard. Both statements were added to the text. We also frequently checked the linearity of the GC-FID by injecting different volumes of the external standard, whose concentration was 12.49 ng/ul, but we do not think this data needs to be reported.*

Line 129: Mention the exact variables that were used for the Bayspline code (e.g. prior standard deviation). Also state measurement/calibration error. Is it possible to show this error in figure 5? *In this version, we have used the calibration by Prah1 et al. [1988], whose slope is the same used by BAYSPLINE for SST below 24 °C. Thus, the propagated error of SST estimates is 0.51 °C and it considers both, the analytical precision of SST and the 1 σ uncertainty of the calibration (0.5°C) reported by Prah1 et al. [1988]. These errors are now plotted in Fig. 6A. In figure 5B, errors of SST offsets are propagated considering the error of SST estimates, and the propagated error of the annual SST, which considers the error given by ODV along latitude and along longitude.*

Line 152: Even though this study seems to have better recoveries than other previous studies using wet-sieves (85%, Magill et al., 2018, Tesi et al., 2016), how can you be sure that there wont be any preferential loss of C37:3 or C37:2, which could ultimately affect your SST results? Could you comment on that? *Preferential solubilization of labile OM within MilliQ water resulting in preferential loss of C37:3 or C37:2 during sample processing cannot be entirely excluded, but we carefully prepared our samples in the minimum possible amount of time (a matter of < 6 hours) to minimize OM exposure to water and OM loss during the fractionation process. The obtained fractions (along with the water in which some of them were collected) were immediately frozen and stored until they were freeze-dried. Considering the time identified in incubation studies for complete alkenone degradation under oxic conditions (2-3 months) [Sun et al., 2004], preferential degradation of the di- or tri-unsaturated alkenone due to free radical oxidation and aerobic bacterial processes [Rontani et al., 2013] in MilliQ water in few hours cannot be entirely excluded but seems unlikely.*

Line 153: Can you explain the significant loss of alkenones during manual columns? *I lost part of the sample (1-2 drops) when loading it to the column with the pipette. I added a short sentence to the text. Instead of comparing the fraction-weighted values to the bulk values did you also use an internal standard to account for the loss/recovery of alkenones? No internal standards were added to avoid the addition of extraneous C (having a different ¹⁴C signal) that would contaminate our samples, as these were intended for subsequent ¹⁴C dating.*

Line 238: Can you state if you recorded C37:4 in BER, which also reflects advection of high-latitude alkenones (Rosell-Melé et al., 1998; Bendle and Rosell-Melé, 2004; Bendle et al., 2005)? *There is a peak in the bulk sample of BER that is consistent with the expected retention time of C37:4. However, our identification alkenone standard only contains C37:3 and C37:2 and we cannot conclude whether the mentioned peak corresponds or not to the tetra-unsaturated alkenone without a masspec.*

Minor comments/ technical corrections:

Line 16: spell out OM and SST as first mention in manuscript. *Done.*

Line 28: (C37:2 + C37:2) should be (C37:2 + C37:3). *Corrected.*

Line 33: also add latitude-dependent (Lutz et al., 2007). *This work explores the vertical flux of POC and its results might not necessarily apply to alkenone fluxes.*

Line 42: define 37:2, 37:3, e.g. UK37'=[C37:2]/([C37:2]+[C37:3]), where [C37:2] and [C37:3] are the concentrations of di- and triunsaturated C37 alkenones, respectively. *Done.*

Line 44: reported precision in Prah1 and Wakeham, 1987 is $\pm 0.5^\circ\text{C}$. *Done.*

Line 55: wrong format for reference. *Corrected.*

Line 65: which hydrodynamic processes are we talking about? Maybe give an example in brackets? *Done.*

Line 68: define OC. *Done.*

Line 95-103: for consistency, add oxic/suboxic conditions to NAT, NAM and BER in text. *Done.*

Line 109: Figure 1: Out of curiosity: why was SHAK06 not described in this study? It was

analyzed in Ausin et al., 2021 for OC in bulk sediment on continental margin sediments. Because the remaining material from each fraction was not enough for alkenone quantification.

Line 114: add abbreviation to clay, similar to fine silt and coarse silt, which is later used in figures and tables. Done.

Line 115: The author refers in Ausín et al., 2021 to Magill et al., 2018 for the method.

Might be worth mentioning here as well. Done.

Line 168: Figure caption 2: Figure 2. C) should be C37:3 and D) should be C37:2. Corrected.

Define abbreviations for CS, FS, C. Done.

Line 171: briefly mention, why alkenone 14C ages in SBB, NAF, BER were not measured. Done.

Line 185: Figure 3 would be easier to read if you would change TOC-foraminifera to another symbol. It currently might be confusing because you use open symbols in panel A for bomb 14C. Done.

Line 190: Figure 4: Define abbreviations for CS, FS, C. Done (also in Figs. 2 and 6).

Line 192: Fig.5. to be consistent with the naming in figure 6C, rename y-axis in panel B "ΔSSTbulk-annual mean". Done.

Line 275: Figure 7: In panel A, x-axis label is missing. Added. To be consistent with the nomenclature of your manuscript rename label for y-axis to OC%. Done. Also, insert is hard to read, maybe its enough to state the R2 from Ausín et al., 2021 in the text, instead of having the insert. Changed as suggested. In panel B, add C37 to y-axis to be consistent with naming (in comparison to Fig. 2A). Done.

References

Prahl, F. G., L. A. Muehlhausen, and D. L. Zahnle (1988), Further evaluation of long-chain alkenones as indicators of paleoceanographic conditions, *Geochimica et Cosmochimica Acta*, 52(9), 2303-2310.
Rontani, J. F., J. K. Volkman, F. G. Prahl, and S. G. Wakeham (2013), Biotic and abiotic degradation of alkenones and implications for U37K' paleoproxy applications: A review, *Organic Geochemistry*, 59, 95-113.

Sun, M.-Y., et al. (2004). "Molecular carbon isotopic fractionation of algal lipids during decomposition in natural oxic and anoxic seawaters." *Organic Geochemistry* **35**(8): 895-908.