Review of Viola *et al.* for *Climate of the Past*

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RECOMMENDATION

Minor revision.

SUMMARY

Viola et al. present a very nice study that explores the potential of mass spectrometry imaging to capture interannual climate variability in sedimentary archives. The data presented here probe the extent to which sedimentary processes may obscure these high-frequency climate signals. This study is an important contribution to the cutting edge of our field – particularly because of the profoundly important climate processes the MSI technique could be used to investigate. The writing and figure design are excellent.

My main comment relates to the mass spectrometry techniques used. I am not familiar with the statistical techniques used in this manuscript and leave their evaluation to the other reviewers.

I look forward to the publication of this work after my comments are addressed.

MAJOR COMMENTS

Methods:

Is there any reason for concern about potential differences in the ionization efficiency of the $C_{37:3}$ vs. $C_{37:2}$ alkenones influencing your results? This is an issue for other mass spectrometer techniques (e.g., GC-MS and HPLC-MS, see (Chaler et al., 2000, 2003; Liao et al., 2023)). If steps were taken to account for this on the analytical side, some additional text outlining that procedure would be helpful to better understand the data.

MINOR COMMENTS

L29–32: Another important aspect of paleoclimate archives is that they allow climate scientists to understand climate processes in warmer-than-present climate states. It may be worthwhile to add a comment to this effect.

L40: a comma is needed after “however.”

L42: remove space between “carries” and the period at the end of the sentence.

L55: “export productivity” is a more appropriate term here than “primary productivity” because the sediments only preserve the proportion of the biological products that are exported from the surface and buried.

L150–151: I think there is a typo or missing word here.

Figure 2 caption: an explanation of the black “Xs” in panel A would be nice.

L220: need a subscript on “C0”

L230: $C_{37:3}$ needs a subscript

REFERENCES

Chaler, R., Grimalt, J. O., Pelejero, C., & Calvo, E. (2000). Sensitivity Effects in *U* k ‘ 37 Paleotemperature Estimation by Chemical Ionization Mass Spectrometry. *Analytical Chemistry*, *72*(24), 5892–5897. https://doi.org/10.1021/ac001014q

Chaler, R., Villanueva, J., & Grimalt, J. O. (2003). Non-linear effects in the determination of paleotemperature Uk’37 alkenone ratios by chemical ionization mass spectrometry. *Journal of Chromatography A*, *1012*(1), 87–93. https://doi.org/10.1016/S0021-9673(03)01188-9

Liao, S., Liu, X.-L., Manz, K. E., Pennell, K. D., Novak, J., Santos, E., & Huang, Y. (2023). Comprehensive analysis of alkenones by reversed-phase HPLC-MS with unprecedented selectivity, linearity and sensitivity. *Talanta*, 124653. https://doi.org/10.1016/j.talanta.2023.124653