Reply on RC3
Jessica Georgina Magdalen Crumpton-Banks et al.

We would like to thank Reviewer 3 for their thoughtful feedback on our manuscript, and give our responses to their suggestions below. Reviewer comments are in italics.

Do you change the resultant measured alkenone unsaturation index (or GDGT ratio, or isotopic composition, or any other lipid/biomarker value) by not crushing? You could, for example, not get complete extraction and one alkenone is preferentially extracted over the other?

Similarly do you reduce the yield of alkenones by not crushing? This would both reduce the utility of the method (as you want to get as much as possible), but also make it more difficult for anyone wanting alkenone concentration, as the extraction efficiency will likely be heterogenous down core if you don’t homogenise.

It is possible that these questions have been answered elsewhere – that someone has experimented with crushing vs not crushing for ASE alkenone/lipid extraction and it matters not a bit, but if that is the case those experiments need citing here, and if it hasn’t been tested, at the very least a discussion of the above would be helpful.

It’s a pity, because the logical addition in this study would have been to crush an aliquot of the sediment, extract in the ASE, and then compare the alkenone data between the crushed and not-crushed samples. This could have ressaured both the organic and inorganic geochemists in the authors proposed new collaborative endeavours.

Nonetheless, this is a neat study and should be published once these minor concerns have been dealt with.

These are all valid concerns and we thank the reviewer to bring these forward. It is in fact true that grinding the sediment would result in a fine powder with most of the foraminifera destroyed. That is why we only use a small rubber mallet to crush the sediment into small pieces that still contain intact foraminifera. It is obviously a trade-off between preserving the microfossils and extracting as much organic material as possible.

Also, this seems to be standard practice in the lab. The cited Zhang et al. 2017 paper for
example describes using a mortar and pestle to homogenize the sediment (but not making a powder) and later using the >250ym size fraction to pick planktonic foraminifer.

It is highly unlikely that the alkenone ratio would be affected by imperfect extraction. The various lipids behave very similarly and all of them are easily dissolved and extracted using the described 5:1 DCM:MeOH ratio. Even though the extraction might be imperfect by not crushing the sediment entirely, we are showing that we can compensate for it by using much more sediment to extract from because it is not affected by the solvents.

**Minor points**

*Section 2.1* This section is rather short, especially compared to the detail in the boron methods. What was the mass of the samples? What volume of solvent was used? What volume of ASE inserts were used? What grade or solvents were used and who supplied them?

Thank you for highlighting your concerns about this section. We have amended the section to address these points.

*Line 160* I wonder whether some of this apparent better preservation amongst the ASE treated samples is because you’ve plausibly done a light organic matter clean. Plausibly this could effect either their appearance, or how well they will sputter coat?

This is an interesting alternative explanation. We have taken pains to indicate that the effect we noticed was slight, and with the caveat that the sample sizes were small (and the effect may therefore be due to the small number analysed). We note though that for *T. trilobus* the gaping observed between the layers appeared slightly greater in the pre-ASE versus ASE samples, which is the opposite to what we would expect to observe if the loss of organic layers was making a visible impact. However, the difficulty in identifying features in the pre-ASE samples might be influenced by the presence of organics and debris on the faces, and we will mention this in the final manuscript.

*Lines 193-8:* This result is surprising. At this point I would have wished I had done SEM on more than 3 individuals? I presume by the time this realisation was made the rest had been thoroughly dissolved?

As the geochemical data shows, this slight feature is not important for the conclusions of the paper, and a detailed SEM study of it is outside the scope of this study. This could be an interesting avenue for future studies, with steps taken to minimise contamination by fragments of the surface faces.

*Figures (generally).* A crossplot of Pre-ASE vs ASE would be informative, potentially with some stats too. I’ve done a quick example of the data in Table 2 in the plot below. A similar plot for the Table 3 data might be more informative than Fig. 4. Incidentally would Not-ASE vs ASE be clearer terminology?

We appreciate this suggestion from the reviewer, although our initial concern with displaying the data in this way was that it is less easy to ensure that the identity of the species/core treatment pairs is clear and accessible to all readers. This is due to the large number of unique markers required (six) and overlap between the markers in some instances leading to markers being obscured. We also note that Reviewer 1 states the paper is “clearly presented” and Reviewer 2 that “The figures are clear”.
Respectfully, we disagree that not-ASE would be clearer terminology than pre-ASE. We feel that the usage of pre- is not misleading as we are referring to samples before and after the ASE treatment process.

*Line 291* “We find no significant difference between the treatments”. You have not done a significance test so you should not state this. You should do a significance test and then you probably can!

We will amend this sentence to “We find that no sample pairs exceed 2SD difference between the treatments for $d^{11}B$” and hope that this addresses your concerns.