

Ashley et al. response to Anonymous Referee #1 (our replies are in bold)

Within their manuscript entitled “Mid-Holocene Antarctic sea-ice increase driven by marine ice sheet retreat”, Ashley et al. establish a link between the impact of meltwater discharge from the Ross Sea ice-shelf cavity and sea ice evolution in the Adélie Land coastal region. Based on geochemical, sedimentological and micropaleontological data sets obtained from IODP core U1357 and nearby core MD03-2601, Ashley et al. identify the meltwater signal originating in the Ross Sea and assess its potential role for Holocene sea ice cover at the core site. These proxy reconstructions are complemented by a numerical model simulating the westward circum-Antarctic routing of meltwater released in the Ross Sea sector via the Antarctic Coastal Current. The manuscript is well written and in a very mature state. A major focus is on the application of fatty acid hydrogen isotopes as a proxy for glacial meltwater. Accordingly, the authors provide an extensive overview on the potential source organisms synthesizing C18 fatty acids and address various aspects relevant for the interpretation of the isotopic values.

We thank the reviewer for this positive and constructive comment.

For background information on and the interpretation of the other proxies applied in this study, the reader is often referred to the supplementary information, which, to my opinion, lowers the readability of the manuscript to a certain extent. Some re-structuring of the manuscript (shifting parts of it into the supplement and vice versa) could help on this.

We thank the reviewer for pointing this out and agree that due to the large amount of information and data included in the paper, much information was moved into the supplementary information which may have become confusing at times. In the final submission we will move some more information into the main manuscript, including a new ‘results’ section which describes the results from our main datasets to make it easier for the reader to understand what new data we are presenting without having to look to the supplementary. In addition, we recognise that the reader is often referred to Fig S2, which contains our grainsize data. Therefore, we will move this from the supplementary into the main text, so that all our original datasets are displayed in the main manuscript to make it easier for the reader.

Concerning the paleoenvironmental reconstruction (i.e. the discussion chapter), I miss a more thorough integration and discussion of other already published East Antarctic paleo records (e.g. Berg et al., 2010; Borchers et al., 2016; Kim et al., 2012). While the authors indeed mention Mezgec et al. (2017) at one instance, I miss the actual discussion of their Holocene sea ice reconstructions for the Ross Sea as this could help to link the sea ice evolution in both areas, which would clearly improve the manuscript.

We will be happy to include a wider discussion of East Antarctic paleoenvironment changes in our final submission including the papers the reviewer has mentioned. However, we note that the study by Berg et al. (2010) was performed in the Rauer Group, an archipelago very close at the Prydz Bay coast, where conditions are strongly influenced by local processes, linked to the presence of the islands and nearby coast. It is therefore perhaps less likely to be representative of the wider environment than other core sites.

minor points:

lines 56-59: these studies only refer to East Antarctica; re-phrase: “...highlight a major baseline shift in East Antarctic coastal sea ice...”

We will amend this in the final revised submission.

line 82: diene/triene HBI ratio: please refer to Belt et al. (2016) and provide brief comment that the diene is also called IPSO25 (at least in more recent papers using HBIs for Southern Ocean sea ice reconstructions)

We will add reference to this in the final revised submission.

lines 154-170: methods chapter 3.4 (HBIs) should be moved and integrated into chapter 3.1 (Organic geochemical analyses)

We will move this section in the final revised submission

line 157: please provide information on the internal standards

We will add this information this in the final revised submission

lines 261-268: make clear that these simulations are already results of this study

We will amend this in the final revised submission by explaining the reason for the model simulations before presenting the results.

line 327: Tang et al. (2008) do not state that *P. antarctica* exists within sea ice; please provide an appropriate reference

We will add a more appropriate reference for this in the final revised submission

line 342: please provide reference for better preservation of biomarker lipids compared to microfossil remains

We will add an appropriate reference for this in the final revised submission

lines 393-394: unclear - what is meant with "...ice that contributed to a marine-based ice sheet collapse along this margin..."

This is referring to the ice that was melting along this margin. We will rephrase this in the final revised submission to make it clearer.

lines 492-529: what do the HBIs reflect in terms of sea ice cover during the Early Holocene?

The HBI diene/triene ratio is very low during this period due to very low concentrations (or absence) of the HBI diene. While this does suggest that sea ice cover was low in comparison to the Late Holocene, the low concentrations mean we cannot confidently interpret any trends during this period.