



Interactive comment on “Southern Ocean bottom water cooling and ice sheet expansion during the middle Miocene climate transition” by Thomas J. Leutert et al.

Anonymous Referee #3

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In their study Leutert and colleagues present a record of bottom water changes from ODP Site 747 spanning 16.0–12.2 Ma. The data and the integration of the records to existing geological data reveals fascinating insights into the transition between the Middle and Late Miocene (MMCT). However, in the present manuscript version the authors are retentive in the presentation and discussion of their results. Therefore, it is strongly recommended to further exploit the potential of the study.

Comments:

- Focus of the study is the MMCT. Leutert et al. define this interval as ~14.5–13.0

C1

Ma, as it contains key changes in the presented records. Given the relatively long definition of this interval it is recommended to define a nomenclature and time intervals for different sub-phases along the key bottom water temperature (BWT) and bottom water d18O (BWd18O) changes. Once introduced they should be used consistently throughout the paper. For instance, statements like ‘Our dataset demonstrates that BWTs at Site 747 decreased by ~3–5°C across the MMCT.’ don’t do justice to the complexity of the recorded changes, since the full cooling magnitude can be already reached between ~14.5–14.3 Ma, i.e. even before the phase of major ice growth.

- The sub-intervals might be chosen to cover the divergence of BWT and BWd18O, including a rapid cooling and abrupt warming into and out-of the phase of minimum BWT (between ~14.3–13.7 Ma). This phase is accompanied by a pronounced decrease (increase) in BWd18O at the beginning (end) of this interval. So far, the focus is towards the end of this interval.

- In the current manuscript version, the timing between BWT/ BWd18O changes to upper ocean temperature changes is touched only marginally. However, the timing of these changes can be a key to better differentiate between various forcing mechanisms.

- Although this paper is a data study, it would be helpful to relate a growing body of relevant model studies to their findings. Interesting aspects might include e.g. the impact of CO₂ or ice sheet changes on upper-ocean and BWT changes across the MMCT. Both factors are expected to have different impacts that can support a mechanistic interpretation, since ice sheet changes might have a more heterogeneous impact on these temperature records. In this context Section 11.3.5 (Impact of Ice on Miocene Climate) in the recent review of Steinthorsdottir et al. (2020) (doi.org/10.1029/2020PA004037) might be a helpful starting point.

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C2