

Response to comment by K. Grant

We thank K. Grant for her helpful comments, which helped improve the manuscript. Please find our answer to comments in blue as well as suggested text changes in green.

First, an important edit would be to plot the ‘maximum probability’ Red Sea RSL record with its 68% +/- or 95% probability intervals (all Red Sea RSL data are available online). As it is, the Red Sea RSL record is plotted in Fig.7 as raw datapoints with the authors’ own smoothing.

Clarification: In Figure 7, we plotted the raw data and the smoothed curve (RSL_smooth) provided in the supplementary material to Grant et al. 2012, not our own smoothing. We have now added the 95% probability intervals as requested.

Interestingly, if the probabilistic Red Sea RSL records were plotted, then it looks like the coral data would overlap within uncertainties, Outside of this bulge, the Red Sea chronology is well constrained over TII thanks to good signal agreement between the Soreq, Mediterranean, and Red Sea records (used for tuning). The authors do not note this and instead assume that there is an issue with the chronology (“Such a mismatch is likely to be related to dating uncertainties associated with the current Red Sea RSL age scale”; pg 13 ln 5)

Thank you for this useful comment. Our explanation indeed could have been more detailed to explain the justification for our treatment of the data and we welcome the opportunity to elaborate on this here. In the supplementary information of Grant et al. (2012, *Nature*), the authors note that the TII transition is more ambiguous and state that the tie points between delta-18O_{pac} from LC21 (Mediterranean core) and the RSL reconstruction from the Red Sea were chosen as follows:

“It is common practice, when graphically correlating records, to anchor them at the mid-point of corresponding transitions, rather than using peaks or troughs in the records. We follow this approach, but make one exception for the tie-point at the base of termination II (main-text Fig. 1). We chose this position (at 136 ka) because an unambiguous tie-point is lacking over the transition due to the different step-wise structures of the two records; the records are much more similar at the base of the transition which means that we can more confidently assign a tie-point here.”

Hence, the authors note that the structure of this interval makes it difficult to establish a confident tie point. There are differences when comparing the details of structure in the Soreq stack -LC21 d18O_{ruber} – LC21 d18O_{pac} – Red Sea RSL that make this correlation challenging. In the revision of the chronology that we propose, the alignment of the rapid TII transition is not significantly affected. Instead the change is proposed in a part of the LC21 d18O_{pac} record where there is not much variability occurring.

Dr. Grant points out that some of the coral age-elevation data do lie within the 95% probability intervals of the RSL chronology published by Grant et al., (2012). Beyond this observation, and

more importantly, the timing of a SL reversal (MWP-2A) that is evident from the sedimentary observations at both Huon and Tahiti (see manuscript text) does not agree with the timing of the same event in the Red Sea using the Grant et al. (2012, Nature) chronology. The reason, therefore, that the revised chronology is proposed is to provide a better agreement between the absolutely dated (U-Th) corals to the Red Sea RSL. The basis of our decision to adjust the Red Sea chronology is (1) that the two U-Th dated coral records agree on the timing of MWP-2A and also (2) given the potential ambiguities of the TII tie point that was used to ultimately transfer the Soreq stack chronology to the Red Sea RSL. Figure 7 also shows that this adjustment coincidentally causes our new, proposed Red Sea chronology to align with the raw depth data. There is no reason to believe that a linear depth-age relationship should hold here, but it may not be coincidental that our correction (based on the coral data) restores this alignment.

Finally, we submit that the MWP-2A (or sea level reversal) is unequivocal in the sedimentary record at Huon and Tahiti and cannot just be attributed to scatter in data points. The coral terrace at Huon must have been constructed under a higher sea level and earlier time than the head corals in Aladdin's cave (that is cut into the terrace) due to basic geologic principles of superposition and cross-cutting relationships. Additionally, the lithofacies and the benthic foraminiferal assemblage in the Tahiti cores provide evidence that paleowater depth deepened during the interval that is bounded by dates on shallow-water corals on either side of the MWP-2A event in the Tahiti cores. Hence the sedimentary evidence (not age-elevation data) are the primary observations that argue for a sea level reversal during the TII transition.

The importance of this adjustment in the chronology is that it compresses the overall duration of TII in terms of sea-level rise and ice sheet decay, and helps to better constrain the relative timing and leads and lags between other components of the climate system.

In the revised version, we have now added further justifications for the revised chronology and we state that the proposed reconstruction is still subject to debate:

“When considering the 95% probabilistic intervals of the Red Sea RSL reconstruction on the chronology from Grant et al. (2012), an overlap is observed with the coral data over the MWP-2A interval, within the stated uncertainties. Still, both coral datasets suggest that MWP-2A occurs several millennia later (i.e. ~135-134 ka) than in the Red Sea RSL reconstruction. This mismatch is likely to be related to the difficulty to precisely anchor the dating of the current Red Sea RSL age scale over this interval (as also discussed in the supplementary information of Grant et al. (2012)). Hence, we propose a revised chronology for the Red Sea RSL record in order to provide a better agreement with the absolutely-dated corals. Given the potential ambiguities of the tie point defined in Grant et al. (2012) to stretch the depth scale across this interval, we find it reasonable to adjust it such that the timing of MWP-2A is more consistent with the absolute ages provided by the Tahiti and Huon Peninsula coral data. “

“This revised chronology is still attached to large uncertainties given the limits of the datasets.”