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Climate of the Past Discussions

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Interactive comment

Interactive comment on "Variations of Mediterranean–Atlantic exchange across the late Pliocene climate transition" *by* Ángela García-Gallardo et al.

Ángela García-Gallardo et al.

angela.garcia-gallardo@uni-graz.at

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We thank Referee 2 for valuable comments and ideas that would improve our manuscript. In the following lines we address the proposed suggestions. Please find our response below each comment.

Referee 2: "Authors assume that most of the d18O signal in their records is due to Sea Surface Temperatures (SST). Nonetheless, the contribution of Sea Surface Salinity to d18O values must be also discussed. It has to be justified why d18O records are only reflecting SST. Usually, paired d18O and Mg/Ca paleotemperature analyses in the same samples must be performed in order to separate the salinity and temperature

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signal (see Cacho et al., 2006). Hence, d18O values cannot be used as temperature proxy without taking into account salinity changes, which are significant between Atlantic and Mediterranean waters.“

Author’s response: This suggestion about the Mg/Ca is good and reasonable in this context. Unfortunately, Mg/Ca analyses are not possible to be performed at this stage. In order to address the salinity issue, we rely on Khélifi et al. (2014) who stated that the d18O signal of surface waters and SSS mainly reflects changes in local freshwater budgets, and in a lesser degree, in the salinity of inflowing Atlantic surface waters in the Pliocene Alboran Sea. In addition, Rogerson et al. (2010) reported that seasonal changes of SSS are small compared to seasonal changes of SST in the region today. Thus, considering that we cannot obtain Mg/Ca data and variations of SSS tend to be small compared to SST, we interpret that changes of d18O must be mainly determined by SST. In the next point there is additional related information.

Referee 2: “It is mentioned that difference in SST between the 2 sites was little to none and estimated SST offsets cannot fully explain the d18O gradients of >-0.05 (page 8, lines 211-215). I think a new figure comparing available SST records from both studied sites and the d18O records is necessary to assess the SST offsets and the relationship between d18O and SST records. This might help to analyze the contribution of SST to the d18O records presented in this study. In addition, the SST offsets must be specified with numbers.”

Author’s response: Since we cannot count on Mg/Ca data, we must rely on available alkenone records for any interpretation on SST. They exist for ODP Site 978 in the Alboran Sea for the interval from ∼3.33 to 2.7 Myrs (Khélifi et al., 2014). In the Gulf of Cadiz, no alkenone-based SST data exists for IODP Site U1389. In its place, we looked at available SST data from ∼3.33 to 2.7 Myrs from its neighbor IODP Site U1387 (Tzanova and Herbert, 2015). We find two problems: 1) the low resolution of the records; and 2) they don’t exist for the same intervals (or they have comparatively different resolution) in the entire studied time-span (e.g., there are only two SST data-points for the U1387 record in our Interval II. Likewise, there are only 4 data points available for the ODP 978 record in our Interval III).

Additionally, Khélifi et al. (2014) emphasize that “a further problem may derive from the fact that SSTs of the near surface habitat of Emiliania huxleyi, which carries the Uk37 signal, strongly differ from that of Globigerinoides ruber near 25 m depth, which carries the d18O signal”. In this case, Mg/Ca would provide a better solution, but again, we cannot count on this option (see previous point). In relation to ODP Site 978, we have tried the SST vs. d18O figure as suggested by referee 2 which showed a positive, yet weak correlation between both records. Regarding IODP Site U1387 in the Gulf of Cadiz, we have some doubts on the age model for the studied time-span.

In consequence, based on the previous issues, we refrain from interpreting any alkenone-based data and from publishing a figure containing low resolution, incomplete and uncertain records.

Referee 2: “In 5.1 section (lines185-187), authors state that G. ruber blooms in spring-summer and G. bulloides in fall-winter. Yet, according to Bárcena et al., 2004. (see fig 5) G. ruber blooms in fall-spring and G. bulloides in spring in the Alboran Sea. Therefore, both species can bloom in spring and, perhaps, the offset in d18O is due to other factors (calcification depths?).”

Author’s response: The referee is right concerning the study from Bárcena et al. (2004) and their findings about the same bloom season for both species. However, Peeters et al. (2002) studied the effects of different factors to the isotopic signature of G. bulloides and Gs. ruber. They concluded, on the one hand, that the depth habitat of both species is similar and, on the other hand, that differences in d18O of both species must result from seasonal differences in the shell production. Despite the possibility of the same calcification season (Bárcena et al., 2004) and indications of similar habitats (Peeters et al., 2002), the latter study concluded that Gs. ruber prefers anyway warmer waters, which finally explains the depleted d18O signature of Gs. ruber with respect to G.

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bulloides in our study.

Referee 2: “I think it is necessary to include a figure showing the main surface currents in the Gulf of Cadiz and Alboran Sea to illustrate what is describe in the Regional setting section.”

Author’s response: We appreciate the suggestion; the main currents will be shown.

Referee 2: “I suggest to include a table with all age datums used for the age model and the age of the main biostratigraphic events. Authors must be consistent with the age of bioevents in text and figure 2.”

Author’s response: The inclusion of a table including bioevents is being considered as well. The issue about discrepancies between figure 2 and text will be corrected in the revised version.

Referee 2: “Since most of the d18O records used in this study are already published, the number of new analyzed samples in this study has to be specified. This can be done in section 3.2 Stable isotope analysis.”

Author’s response: The number of samples will be indicated accordingly.

Referee 2: “Authors use Ma and Myr; and Ka and Kyr. They should use only one type of nomenclature to be consistent in both figures and text.”

Author’s response: As we replied to Referee 1, we consider that we are following the same rule consistently. According to international conventions (see Christie-Blick, 2012), we are using Ma to indicate a point in time, and Myrs to indicate a time span (e.g. intervals) throughout the manuscript.

Referee 2: “Instead of using Gdes. ruber, authors must use G. ruber throughout the manuscript.” Author’s response: Since there is a consensus from both referees on this 4-letter abbreviation, we will decline using the 4-letter abbreviation but we keep a distinction between both genera Globigerina and Globigerinoides using Gs. in the last case. The 2-letter genus abbreviation has been extensively used in previous studies.

In relation to comments and minor revisions on the annotated manuscript, corresponding changes will be incorporated in the revised version accordingly.

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