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Climate of the Past Discussions

Interactive comment on "Sea surface temperature variability in the central-western Mediterranean Sea during the last 2700 years: a multi-proxy and multi-record approach" *by* M. Cisneros et al.

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We really appreciate and thank the reviewer for the comments and corrections. We are in agreement with almost all the suggestions and thus, they will be taken into account in the revised version. Reviewer's comments (in capital) and our answers below.

1. ABOUT SAMPLE HETEROGENEITY AND REPRESENTATIVITY OF RECONSTRUCTED SIGNALS THE E-P BALANCE WAS ESTIMATED BY CORRECTING TEMPERATURE EFFECT ON G. bulloides δ18O WITH Mg/Ca-SST OBTAINED ON THE SAME ORGANISM. HOWEVER, THE SAMPLES FOR Mg/Ca AND δ18O MEASUREMENTS WERE SEPARATELY PREPARED ALTHOUGH IT COULD BE POSSI-

BLE TO CRUSH, HOMOGENISE AND MECHANICALLY CLEAN TEST FRAGMENTS BEFORE SPLITTING FOR Mg/Ca AND δ18O ANALYSIS. TAKING INTO ACCOUNT THE SMALL VARIABILITY OF SIGNALS, WHAT WOULD BE THE SIZE OF UNCERTAINTY RELATED TO SAMPLE HETEROGENEITY?

-Specimens for Mg/Ca and δ18O measurements were picked together from a very restrictive size range (250-355 microns) but then crushed and cleaned separately, this is now better described in the Section 3.5 of the manuscript. Certainly, both Mg/Ca and δ18O values can be size-dependent (Elderfield et al., 2002) but this effect can be minimized when the picking is performed within a narrow size range. Reported δ18O and Mg/Ca data in G. bulloides within the size fraction of 250-300 microns and 300-355 microns show a range of variability of 0.13‰ and 0.31 mmol mol-1 respectively. This could potentially be the range of expected sample heterogeneity for the analysed samples. Nevertheless, the fact that the picking process for both measurements was performed together, within a narrow size fraction, and the samples split later in two sub-samples, can minimize the sample heterogeneity derived from selective picking of different size fractions during independent picking processes.

SINCE CORE MR3.1 WAS SPLITTED INTO MR3.1A AND MR3.1B, AND THE SPLITTED SAMPLES WERE SEPARATELY ANALYZED, SCATTER PLOT OF G. bulloides Mg/Ca, δ18OC AND CALCULATED δ18OSW OBTAINED FOR MR3.1A AND MR3.1B WILL ALLOW EVALUATING SUCH INTERNAL VARIABILITY.

- This is an interesting suggestion, we have performed this comparison and the obtained average of the suggested internal variability has been $\pm$0.09 mmol mol-1 in the Mg/Ca records (Figure S1), which is equivalent to approximately <0.15°C and very close to those reported by Elderfield et al., (2002). In reference to δ18Oc records and the calculated δ18Osw, averages of the obtained differences have been $\pm$0.05 and $\pm$0.10 VPDB‰ respectively.

IN RELATION TO THE ABOVE-MENTIONED POINT, IT IS NOT CLEAR HOW CORE

MR3.1A Mg/Ca DATA OBTAINED WITH THE REDUCTIVE STEP WERE CONVERTED INTO SST VALUES. THIS POINT SHOULD BE ADDED TO THE TEXT, AND AGAIN THE SCATTER PLOT WILL PROVIDE INFORMATION ON CLEANING EFFECT AND SAMPLE HETEROGENEITY.

-The Mg/Ca decrease of 23% by the reductive step in core MR3.1A was estimated by comparison with the obtained Mg/Ca values in MR3.1B no cleaned with the reductive step (Figure S1). Therefore, Mg/Ca values in MR3.1A were increased by 23% and then, SSTs were calculated following the same calibration than the other cores. This explanation has been added in section 3.5 of the manuscript.

BESIDES, THE Mg/Ca DECREASE OF 23% BY THE REDUCTIVE STEP IS QUITE LARGE COMPARED TO THE GENERAL OFFSET OF 8 TO 10% (BARKER ET AL., 2003; YU ET AL., 2007). INDEED, PENA ET AL. (2005) REPORTED A LARGER OFFSET BUT THE STUDIED SAMPLES CONTAIN MN CARBONATES WITH HIGH MG. WHAT WOULD BE POSSIBLE REASONS FOR THIS STRONG CLEANING EFFECT OBSERVED FOR THE MINORCA SAMPLES?

-There is not any exhaustive study about the effect of the reductive step in different foraminifera species. Yu et al., (2007) worked with benthic foraminifera and they could potentially be more resistant to dissolution. Barker et al (2003) worked with different planktonic species reporting and average Mg/Ca lowering of about 15%. Fig. 3 in Barker et al., (2003) show that significant differences exist between the considered species but for this part of the study, Barker et al. did not include G. bulloides. It could be the case that a species highly porous such as G. bulloides would be more sensitive to dissolution. Comments on this have been implemented in section 3.5 of the manuscript.

ANOTHER WAY TO EVALUATE THE REPRESENTATIVITY OF SIGNALS IS TO COMPARE WITH Mg/Ca-SST AND δ18O OF G. BULLOIDES, ESTIMATED δ18OSW AND UK'37-SST ALREADY OBTAINED FOR THE MINORCA SITE OVER THE LAST 2000

YEARS (MORENO ET AL., 2012). THESE COMPARISONS WILL ALLOW ESTIMATING THE SIZE OF SIGNIFICANT VARIABILITY. THE AUTHORS MAY ADD THE RELATED UNCERTAINTY OF RECONSTRUCTED SIGNALS TO THE STACK RECORDS. THIS WILL HELP DISTINGUISHING ROBUST VARIABILITY FROM INTERNAL NOISE AND REINFORCE THE INTERPRETATION DEVELOPED IN DISCUSSION SECTION.

-We do not think that the proposed comparison with Moreno et al., (2012) data could necessarily provide information on the representativity of the signal. The data published by Moreno et al., (2012) in the Menorca Rise are part of the data set already used in this study. Both Mg/Ca and UK'37 records from that study are incorporated in this manuscript (MIN 1 and 2) but chronologies have been improved according to the description in section 4 and SST calibrations have been changed to include data from Mediterranean core tops (see sections 5.1). Consequently, comparison with Moreno et al., (2012) can not provide any further information. We are not sure if it is proposed in here to use the actual comparison between different proxies Mg/Ca and UK'37, to assess the representativity of the record. As it is already argued in our manuscript (sections 5.1 and 5.5) we interpret that G. bulloides-Mg/Ca-SST are representative of spring season, consistent with the reported period of G. bulloides bloom in the region and with the comparison of our SST reconstructions with a oceanographic data compilation of the region (MEDAR GROUP, 2002). In contrast, UK'37 is interpreted to reflect a more annual average biased towards the colder season since coccolitophoral productivity in summer is extremely low (see discussion in section 5.5). For this reason these two records do not represent the same climatic signal and cannot be used to assess the representatively of individual proxies.

2. ABOUT THE CHRONOLOGICAL CONSTRAINS USING GEOCHEMICAL DATA. THE PEAKS OF Mn XRF INTENSITY OF BULK SEDIMENTS AND OF FORAMINIFERAL Mn/Ca (NOT CLEANED WITH A REDUCTIVE STEP) ARE EXPECTED TO BE ALMOST SYNCHRONOUS BECAUSE THEY BOTH REFLECT

REDOX STATE OF PORE WATER. IN CONTRAST, REDUCTIVELY CLEANED PLANKTONIC FORAMINIFERAL Mn/Ca VALUES WERE USED AS AN INDICATOR OF SEAWATER MN CONCENTRATION IN WATER COLUMN WHERE PLANKTONIC FORAMINIFER CALCIFIED (KLINKHAMMER ET AL., 2009). SINCE FORAMINIFERAL MN CONTENTS OF CORE MR3.1A WERE OBTAINED WITH A REDUCTIVE CLEANING, IT IS NOT OBVIOUS WHETHER THE SYNCHRONOUS PEAKS WITH MN XRF INTENSITY OF BULK SEDIMENTS ARE EXPECTED (FIGURE 6). IT WILL BE INTERESTING TO PRESENT THE FORAMINIFERAL MN CONCENTRATION AS MN/CA RATIO (FIG. 6, FIGURE CAPTION AND THE TEXT) SINCE THE VALUE OF THIS RATIO WOULD ALLOW DISTINGUISHING PORE WATER OR SEAWATER ORIGIN Mn.

-This is a good observation, since Mn concentration in foraminifera tests after the reductive cleaning not necessarily should reflect pore water conditions. This is only the case of record MR3.1A. It has to be noted that the selected tie points in this case have mostly been defined in base to its pair record, MR3.1B, where reductive cleaning was not applied and structures are very similar to those of core MR3.2 measured by XRF scanner. For that reason, although some questions can arise on the source of the Mn signal in G. bulloides the pair record provides a solid evidence to correlate this core to others.

ANOTHER CONCERN ABOUT THE CHRONOLOGICAL CONSTRAINS WITH GEOCHEMICAL DATA IS DIFFERENCE OF DATA RESOLUTION. THE TIE POINTS SHOWN IN FIGURE 5 (Mg/Ca-SST) AND FIGURE 6 (Mn) SEEM TO BE AFFECTED BY TEMPORAL RESOLUTION OF RECORDS. FOR INSTANCE MR3.1B FORAMINIFERAL MN AND BULK SEDIMENT XRF Mn PEAKS ARE NOT TOTALLY SYNCHRONOUS BECAUSE OF DIFFERENT RESOLUTION OF THE RECORDS (FIG. 6B). SINCE THE INITIAL AGE CONSTRAIN WAS ESTABLISHED BY BAYESIAN MODELS, I BELIEVE THAT THE AUTHORS CREATED THE COHERENT AGE MODEL. HOWEVER, ASSESSMENT OF AGE UNCERTAINTY WILL BE USEFUL TO

AVOID OVER-INTERPRETATION IN THE FUTURE STUDIES.

-This is also a good observation, chronological error for those cores based on stratigraphical tools, will rely in the sedimentation rates and sampling resolution. This is now took in account and indicated in a new table prepared for the Supplementary Material (Table S1, Supplementary Information).

Please also note the supplement to this comment:
http://www.clim-past-discuss.net/11/C3210/2016/cpd-11-C3210-2016-supplement.pdf

Interactive comment on Clim. Past Discuss., 11, 5439, 2015.

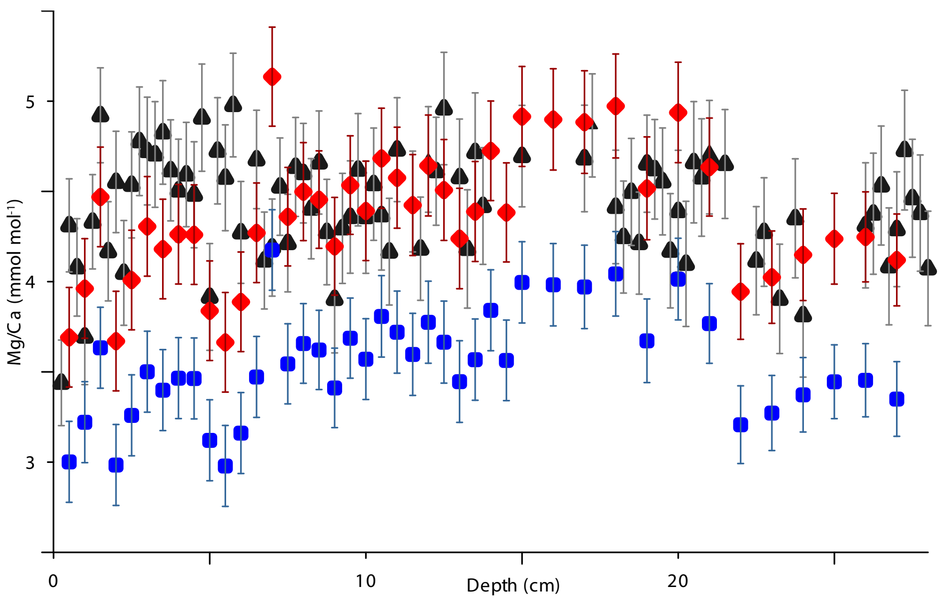

Fig. 1. Fig. S1: Comparison of Mg/Ca records derived from the two halves of the same core MR3: MR3.1B (black triangles), and MR3.1A (blue squares) and MR3.1A after the correction of 23% (red rhombus). Vertica