

This is the answer to Reviewer #1 about the manuscript cp-2010-43 « Sea-surface salinity variations in the northern Caribbean Sea across the mid-Pleistocene transition » by Sepulcre *et al.* submitted to *Climate of the Past*. First, we thank Reviewer #1 for the evaluation of our manuscript and for its constructive comments, and we are pleased to know that our work has been appreciated. The major point of the review is of methodological purpose and, especially, relies on the use of the alkenone paleothermometer and the effect of carbonate preservation on paleoclimate signals. We acknowledge most of the remarks made by Reviewer #1 and we provide a point by point answer to all the comments. We also provide two Figures and one Table as auxiliary material. The suggestions made by Reviewer #1 have contributed to improve the manuscript and all the minor comments pointed out have also been considered in the revised version of the manuscript.

In the following, we answer in detail to the specific comments of Reviewer #1.

1. Preservation state of calcium carbonates.

The first comment of the reviewer concerns the impact of preservation state of calcium carbonates in core MD03-2628 records, in relation to modern and past deep oceanic circulation at the studied site.

Long-term changes in the preservation state of planktonic foraminiferal tests may have induced the observed shift in the $\delta^{18}\text{O}$ values measured on *Globigerinoides ruber* (*G. ruber*). We can gain some insight into past calcium carbonate preservation state at core MD03-2628 site from the mineralogical and geochemical study of the sediment fine fraction ($< 63 \mu\text{m}$). In a previous work, we have shown that calcium carbonate minerals are generally well-preserved over the last 940 kyr, as indicated by high amounts of metastable fine aragonite as well as magnesian calcite (Mg-calcite) (Sepulcre *et al.*, 2009). We observed subtle changes in the preservation state of Mg-calcite, that we interpreted as changes in the ventilation rate of the water mass bathing the core site, the Antarctic Intermediate Water (AAIW). Our records suggest a better preservation state during glacial stages of the last 400 kyr. As we do not observe any long-term change in the glacial $\delta^{18}\text{O}$ values of *G. ruber* over the last 940 kyr, we believe that changes in the preservation conditions cannot account for the variations observed in the $\delta^{18}\text{O}$ record during interglacial stages at Mid-Pleistocene Transition timescale. To clarify this point, we mention the impact of carbonate preservation in the Section 5.1.2. of the revised manuscript.

In addition, Reviewer #1 added some precisions about the modern deep circulation in the Caribbean Sea, which is quite different from the Walton Basin. Indeed, the Walton Basin depth is shallower than the central Caribbean Sea and the deep water masses flowing at the seafloor between both areas are different (see Johns *et al.*, 2002, in Schmidt *et al.*, 2006; Tomczak and Godfrey, 2003). To avoid any confusion, we have taken into account this comment in the revised manuscript.

2. The alkenone paleothermometer

The reviewer questions the use of the alkenone paleothermometer instead of the Mg/Ca.

We already analysed the Mg/Ca paleothermometer on core MD03-2628 planktonic foraminifer *G. ruber* (Figure S1). Unfortunately, the Mg/Ca results have shown contamination problem with Mg-calcite of which Mg/Ca ranges between 80 and 150 mmol/mol (Sepulcre *et al.*, 2009). The obtained Mg/Ca foraminiferal values vary from 4.5 to 9.4 mmol/mol with higher values during glacial periods, which is higher than the usual range of values for *G. ruber* specie and opposite to the expected trend (Figure S1). Two different cleaning methods were tested: « Mg/Ca technique » and « Cd-cleaning » (e.g., Barker *et al.*, 2003 and 2005; Rosenthal *et al.*, 2004), and none of them had permitted to eliminate the Mg-rich contaminant.

Thus, we decided to measure the alkenone in order to obtain a reliable paleo sea-surface temperature (SST) signal.

We also discussed the possible bias on hydrological ($\delta^{18}\text{O}$ of seawater) reconstructions related to ecology of foraminifera and the coccolithophorids by considering 1) their growth depth and 2) their growth seasonality based on modern conditions (Section 2.4.). Concerning the SST, we have found that the seasonality is small in surface waters in the Northern Caribbean Sea (Section 2.1.). At the studied site, the thermocline is not well-defined, with nearly constant temperature values of around 27°C down to 50 m of water depth, followed by a progressive decrease to reach 15°C at 400 m (Figure S2). Since coccolithophorids and *G. ruber* both dwell in nearly the same depth range in the water column (Figure S2, see Kameo *et al.*, 2004, and Schmuker and Schiebel, 2002, for references about coccolithophorids and planktonic foraminifera ecology, respectively, in the modern Caribbean sea), they inhabit under almost identical temperature conditions. In the past, changes in the seasonality or in the ecology of coccolithophorids and of *G. ruber* are difficult to estimate. The low sedimentation rates at core MD03-2628 site (2 and 4 cm/kyr during glacial and interglacial stages, respectively) may have contributed to smooth the seasonality signal, attenuating the potential difference of reconstructed temperature based on coccolithophorids and planktonic foraminifera. Reconstructions of the stratification between surface and subsurface waters in the Northern Caribbean Sea for the past 300 kyr have shown that changes in the coccolithophorids population were controlled by the nutrient supply rather than the temperature influence, and that the studied groups have always occupied the first 50 m of the water column (Kameo *et al.*, 2004). So, coccolithophorids should have always recorded past temperature changes of the upper water column in the past. Concerning planktonic foraminifera, since *G. ruber* is a symbiont-bearing species, its migration in the water column deeper than 50 m seems unlikely. Thus, we believe that changes in the growth depth and seasonality would have not altered significantly the climatic signal in the past SST record. In order to improve the clarity of the discussion, we have added the potential effect of changes in the seasonality and growth depth on core MD03-2628 record in the Section 4.2.

3. Methodology of the $\delta^{18}\text{O}$ analysis

The reviewer asked if the analysis of 5 to 10 individuals is a correct approach to assess the $\delta^{18}\text{O}$ signal.

$\delta^{18}\text{O}$ analysis have been performed on a Finnigan Delta Advantage mass spectrometer directly coupled to an automatic carbonate preparation device (Kiel device III) which is dedicated to the measurement of small samples providing low gas amounts. In addition, we have tested the reproducibility of our approach by measuring replicates of same levels (Table S1) at different depths in the core. The results of these tests are presented in Table S1, and there is no significant difference between the replicate measurements of each level, giving us confidence in our technical approach.

4. Calibration of alkenone SST

The reviewer questions the use of the Sonzogni *et al.* (1997) calibration for the calculation of past SST from the alkenone measurements.

The interest of the calibration of Sonzogni *et al.* (1997) is that it has been especially performed for temperatures higher than 24°C (Figure S3). The global calibration provided by Conte *et al.* (2006) aimed at taking into account the full range of temperatures by using a polynomial approach. However, this is not fully sufficient to account for the decrease in the sensitivity of the U^{K}_{37} proxy at temperatures above 24°C (Figure S3). The work of Sonzogni *et al.* (1997) was focused on the refinement of this part of the calibration, and provided detailed analysis for higher temperatures, with a linear relationship between the U^{K}_{37} proxy

and temperatures (Figure S3). This linear trend has allowed us to obtain precise past SST estimates from the U^{K}_{37} proxy inside this range of temperatures, which is always higher than 24°C. If temperatures at the studied site had decreased below 24°C, we would have been obliged to combine two calibrations, such as Conte *et al.* (2006) and Sonzogni *et al.* (1997). Moreover, when we superimpose both calibrations for high temperatures, the differences between both approaches are minimal (Figure S3). To clarify this point, we have added the SST calculation with the Conte *et al.* (2006) calibration in the Figure 4 of the manuscript, and we have developed the discussion about the calibration of alkenone SST in the Section 4.2. of the revised manuscript.

5. Age model

The reviewer asks precisions about the age model.

The age model of core MD03-2628 is based on ^{14}C measurements for the upper part of the core, isotopic stratigraphy, and paleomagnetic measurements. As the age model has been fully developed and discussed in another published paper (Sepulcre *et al.*, 2009), we only refer to this article in the Section 4.1. of the revised manuscript.

6. Comparison between SST records of the Caribbean Sea

The reviewer questions about the differences between the SST records of the Caribbean region.

The comparison between core MD03-2628 SST record with other SST reconstructions available in the Caribbean Sea shows an overall good agreement despite some differences as noticed by the reviewer, especially during MIS5. If we take into account the uncertainty associated to the SST reconstruction methods (0.7°C and 0.4°C for alkenone and Mg/Ca paleothermometers, respectively), most of the SST differences are within the uncertainty. However, considering all the results at face value, SST records during MIS5e are still different, with higher SST for the Mg/Ca record of Schmidt *et al.* (2006) than for the alkenone reconstruction. One of the possible explanations for the offset is the different sedimentation rate of the archives: the lower time resolution of core MD03-2628, may have smoothed the SST signal and its amplitude compared to the record of Schmidt *et al.* (2006). We agree that this temperature difference could have an impact on the calculated $\delta^{18}O$ of seawater, leading to slightly higher values during the last interglacial. However, the long-term $\delta^{18}O$ trend that we discuss already appears in the $\delta^{18}O$ of *G. ruber* without SST correction. On average, the temperature signal only accounts for around 0.2‰ of the total amplitude of change in the $\delta^{18}O$ signal during Terminations. This is of the same order of magnitude than the error in the $\delta^{18}O$ corrected from SST ($\delta^{18}O_{SST-corr.}$) after propagation (0.23‰) and lower than the global amplitude signal of 1.46 ‰ in the $\delta^{18}O_{SST-corr.}$ during Terminations. Thus, our interpretation over the Mid-Pleistocene Transition is still valid.

7. Minor comments and suggestions

The reviewer suggested some corrections and bibliographic citations that we have included in the revised manuscript.

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