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Climate of the Past Discussions

Interactive comment on "Magnitude and timing of Equatorial Atlantic surface warming during the last glacial bipolar oscillations" *by* S. Weldeab

Anonymous Referee #1

Received and published: 2 July 2012

The paper of S. Weldeab "Magnitude and timing of Equatorial Atlantic surface warming during the past glacial bipolar oscillations" is supposed to be published in "Climate of the Past Discussions". Primary goal of the submitted paper is to relate high-resolution centennial SST records from the eastern equatorial Atlantic to the millennial-scale bipolar oscillations of the last glacial and MIS3. According to the interpretation of S. Weldeab based on his high-resolution geochemical proxy data series, the eastern equatorial Atlantic warmed rapidly with the onset of Heinrich events, supporting the concept of tropical Atlantic warming in response to perturbations of the Atlantic meridional circulation. However, the persistence of elevated SST in the eastern equatorial Atlantic after the rapid end of the Heinrich events appears not to be consistent with previous model results that suggest both rapid warming during and rapid cooling after the termination of Heinrich events.

This topic is of quite large interest to the paleoceanographic community and has the potential to be published in a highly ranked journal. The paper is very well-written, concise, and clearly structured, and the figures are of high quality. I acknowledge the author′s statement at the beginning of Chapter 4.2 that quite a large number of Mg/Ca and δ18O data were already published previously in Weldeab et al. (2007). His notions on the temporal and spatial seasurface temperature development across the equatorial Atlantic and his new views of how it relates to the N-Atlantic climate evolution are quite interesting. Nonetheless, I hesitate to recommend this paper for publication without explicit improvement and thorough revision. I added a few comments and suggestions that may be useful to the author to improve his manuscript:

Methods: Core stratigraphy

Indeed, the timing of SST and δ18O across Heinrich Events at centennial resolution, and the demonstration of oceanic and atmospheric teleconnections between low and high northern latitudes is of outstanding importance to understand the climate system. Hence, the core stratigraphy is crucial to any conclusion drawn from the proxy data, and should be presented and discussed in much more detail, even if basics were already published previously (Weldeab et al., 2007). If I am correct, there are only 5 AMS14C-dates available for the discussed time period from 25-75 ka, with ages from ca. 27 to 42 ka BP (Weldeab et al., 2007, supplement). This is to my mind an insufficient data base to really pinpoint the timing between SST and δ18O of core 2707 and N-Atlantic Heinrich Events. I would expect for one selected Heinrich Event at least, the improvement of the stratigraphy based on several AMS14C-datings. What kind of reservoir age was used to calculate calendar ages? Also, benthic δ18O are essential to further support the proposed core stratigraphy. Why haven′t such data been added as done in Weldeab et al. (2007) for Termination II?

Methods: Foraminiferal Mg/Ca

The author presents Mg/Ca from G. ruber (pink). It should be mentioned in this respect

CPD

8, C735–C739, 2012

that there are absolute Mg/Ca differences between G. ruber (pink) and (white), and that most Mg/Ca vs. temperature calibrations were established for G. ruber white. Why did the author measure the pink variety? That should be briefly discussed. Also, different morphotypes of G. ruber (sensu stricto and sensu lato) reveal measurable differences in both Mg/Ca and δ18O and point to different living depths. This topic should be discussed briefly, and the according references should be acknowledged in the reference list (e.g. Wang, 2000; Steinke et al., 2005). I may have missed it, but the authors forgot to mention the assumed living depth of G. ruber (pink)?

Results and Discussion:

In particular, I like the discussion on G. ruber Mg/Ca with respect to the calcite saturation state of the ocean. Also, the discussion of the salinity effect on foraminiferal Mg/Ca is very conclusive and again, stresses the large potential of foraminiferal Mg/Ca for paleoceanography.

There is apparently a lead of Mg/Ca over δ18O during the Heinrich events, with SSTMg/Ca becoming warm, and subsequently G.ruber δ18O becomes lighter. Such a lead/lag pattern was described earlier for the deglaciation (Termination 1 and II) by Lea et al. (2000), Nürnberg et al. (2000), and most deeply discussed by Visser et al. (2003) for the tropical Pacific and Atlantic oceans, with a temporal offset of up to several thousand years. Even for core 2707 (as presented in Weldeab et al., 2007), such temporal lead of Mg/Ca over δ18O seems to hold, most explicit for Termination II. How, in this respect, behave the benthic δ18O? Are salinity changes due to riverine freshwater input or strengthened evaporation at times of significant warming affecting the planktonic δ18O? How prominent would be such effects in δ18O?

Further:

Fig. 1: This figure is to my mind redundant. So, if the author is asked to cut down the length of his manuscript, the very simplified ocean current pattern in Fig. 1 could be easily included into Fig. 2. The core position of the reference site GEOB3910-2 could

CPD

8, C735–C739, 2012

be left out.

Fig. 2: Although very colorful, the different symbols in the xy-diagrams can hardly be differentiated. This should be improved. For completeness, the G. ruber Mg/Ca vs. temperature calibrations of McConnel & Thunnel (2005), Lea et al. (2000), and Regenberg et al. (2009) could be included and acknowledged.

Fig. 3: The figure is informative, but could be easily included into Fig. 4. The stratigraphy of core MD2707 was already presented and discussed in Weldeab et al. (2007) in much more detail, which should also be done in this paper as the stratigraphy is essential for all ongoing interpretations. At least, the AMS14C-dates should be marked. As pointed out above, the only 5 AMS14C-datings within the period ~27-42 ka are not convincing, when trying to relate the eastern equatorial Atlantic SST variations to N-Atlantic Heinrich events and to resolve for leads and lags.

Fig. 4: The author should clarify also in the figure caption whether the presented data were already published elsewhere.

Fig. 5: The authors compare their G. ruber Mg/Ca-temperature record, which apparently reflect annual summer temperatures from 25 m (?) water depth, to alkenone-derived SSTs from the western equatorial Atlantic and conclude that the SST development in the western and eastern equatorial Atlantic was different during the Heinrich events. It should be added in this respect, when (season?) and where (water depth?) the alkenone-derived temperature signal was most likely formed. Is it justified to directly compare temperature reconstructions derived from different proxies? Are there Mg/Ca-temperature records from the western equatorial Atlantic available, which could be preferentially consulted?

Fig. 6: Curves are difficult to distinguish! Use better colors (e.g., green) and open symbols.

Supplement download: Only one figure with SST reconstructions, no figure caption!

CPD

8, C735–C739, 2012

The reference list needs some additions as pointed out above.

The abstract should start with the motivation of the work, not with mentioning the results of the core-top study.

The phrasing of titles of Chapter 4.1 and 4.2 – although being appropriate - lack some fantasy and deserve improvement.

Interactive comment on Clim. Past Discuss., 8, 1737, 2012.