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Climate of the Past Discussions

Interactive comment on "Extreme warming, photic zone euxinia and sea level rise during the Paleocene/Eocene Thermal Maximum on the Gulf of Mexico Coastal Plain; connecting marginal marine biotic signals, nutrient cycling and ocean deoxygenation" *by* A. Sluijs et al.

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Dear Dr. Thomas,

Thank you very much for your comments on our manuscript. We will reply to all of them in the revised version, most notably involving more correct referencing, typos and textual organizations. Thank you for noticing these. We clarify your more major points below. Sincerely,

On behalf of all authors, Appy Sluijs

6467: sorry to be dumb, but why does an increase in mag sus imply an unconformity?

Reply: This was poorly explained in the first version. The change in magnetic susceptibility marks a significant lithological change interpreted to reflect an unconformity. This will be included in the revised manuscript.

6468: but does this discussion of stratigraphy and unconformities finally imply that you may miss the very earliest part of the PETM or not?

Reply: We might indeed miss the earliest part of the PETM. We will explicitly mention this in the revised version.

6473: earlier on you referred to publications by co-author Sessa et al, indicating a paleodepth <50 m from invertebrate fossil assemblages. For what part of the section would that be valid -Paleocene or PETM or both? semiquantitaive estimate of RSLR?

Reply: The paleodepth estimate regards the deposition of a fossiliferous marine tongue within the Bashi, which in the core is stratigraphically above the CIE excursion by at least 5 meters (core loss immediately below this fossiliferous unit results in an estimate of this thickness). NP10 is several 100s of Kyrs younger than the PETM (e.g., Vandenberghe et al. 2012). Below this part of the section, no quantification of sea level has been carried out, dominantly because of the absence of calcareous benthic microfossils. Based on lithology and the overwhelming dominance of terrigenous organic matter, over marine, it was presumably very close to the coast and therefore very shallow, perhaps even lagoonal. The magnitude of sea level rise is very hard to determine; in this paper we note an increase in distance to the coast but this information cannot be quantitatively turned into RSLR estimates. This information will be included in the revised version. Notably, the stratigraphic information in the section on regional stratigraphy and in a figure, and the sea level information in the discussion on sea level.

6476: not clear to me (and I suspect other readers who are not experts in Gulf Coast

stratigraphy). To what level in the studied core would the T4 sand correlate? Could the bones have been transported? What parts were recovered?

Reply: This is a great question; there are no independent means to correlate the T4 sand to the Harrell Core apart from the position of the distinct glauconite-rich unit, which we assume to be correlative as the onset of the PETM in this region. Following this logic, the T4 sand, which is part of the PETM according to the literature, was deposited during the PETM but not during the onset of the PETM. Quantitatively, however, determining the time between the base of the glauconite-rich unit and the T4 sand is not possible because of the poor constraints on the sedimentation rates within the glauconite unit. In the revised version we will clarify these arguments related to the age of the T4 sand, including statements on the above uncertainties.

6477-6478: I agree with Jerry – in my opinion you must refer to seasonality here. It's what we see in all the world's dead zones today (including my playground in Long Island Sound) – after all, without stratification it's really hard to go anoxic, and depths <50 m (as in Long Island Sound) you must have vertical mixing due to storms (and hurricanes) reaching bottom and mixing the whole water column during stormy season. Option 4 looks much more probable to me than option 3 since benthic foram lining indeed oxidize easily. Thomas 1998 also compiled information on oxygenation levels at various sites, updated in the appendix to Winguth et al., 2012.

Reply: This is a very good point and we will include this in the manuscript.

6478: I do not really like the phrase 'Ocean circulation may have stagnated', and it is not what we say in Winguth et al. I do like the comparison to the present 'dead zones', but mainly because of the parallel of eutrophication in coastal zones (for PETM maybe due to increased hydrological cycle-weathering –nutrient input; see also Ravizza et al 2001 Paleoceanography). I agree with Lee about potentially low salinities influencing stratification, although I would say that benthic forams do not quite look like full anoxia at the bottom in Spitzbergen (Nagy et al 2013, Polar Research) – how does that work

with dinos and invertebrates?

Reply: We will include the option of seasonality for anoxia and rephrase the sentence regarding the stagnation of circulation.

6479-6480: see also argument in Paytan et al. 2007 Geology 35 1139-1142

Reply: Thanks for the suggestion.

For your compilation: Note that at Site 1263 the d18O values in benthics indicate a much larger warming (âĹij10oC) as said above. The lack of bioturbation and presence of lamination in Kennett & Stott are not really there (Thomas & Shackleton 1996; see core photographs; decrease or change in character in bioturbation, yes). I would now argue that we have no solid evidence for low oxygen in bottom waters at 689-690 (as reflected in that appendix of Winguth et al), but we do have evidence that there was rather widespread deoxygenation in the upper water column during the PETM (non refereed abstract, Lu, Z., Thomas, E., and Rickaby, R., 2013, I/Ca in foraminiferal shells as a paleoceanographic proxy. PP43D-02, 2013 Fall Meeting, AGU).

Reply: Regarding the compilation; only sea surface temperature anomalies are included (here site 527; Thomas et al 1999), not deep ocean temperature anomalies. We will change the inferences regarding 690 and 689.

Interactive comment on Clim. Past Discuss., 9, 6459, 2013.