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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. Fluegeman,

Thank you for your evaluation of the biostratigraphy. Your point essentially comes down to the occurrence of Pseudohastigerina wilcoxensis in the Bells Landing Marl. As you indicate, Wade et al. (2011), in their review of planktic foraminifer biostratigraphy, indicate that the first occurrence of this taxon as calibrated at the GSSP in Africa is in the

earliest Eocene. A simple biostratigraphic implication would be that therefore the Bells Landing Marl must be Eocene, although this is inconsistent with all published biostratigraphic interpretations on the Gulf Coastal Plain (see below). Crucially, Mancini and Oliver (Mancini and Oliver, 1981) note that P. wilcoxensis likely evolved from Planorotalites chapmani during the Late Paleocene, partially based on 'somewhat atypical' specimens of P. wolcoxensis found in lower Tuscahoma marls. If P. wilcoxensis evolved in the study region it may not be surprising if its first occurrence was earlier here than in Africa. Indeed, its first occurrence was previously reported to be diachronous with latitude (Pardo et al., 1997).

Below, are sections regarding the age of the upper Tuscahoma Fm and Bashi Mb that we will include in the revised version of the manuscript. It shows that 1) based on planktic foraminifer biostratigraphy, it cannot be positively concluded that the Bells Landing Marl is Paleocene, but 2) calcareous nannofossil biostratigraphy is inconsistent with an Eocene age of the Bells Landing Marl and indicates that it represents late Paleocene zone NP9. We also further substantiate that the Bashi represents NP10 and exclude the suggestion by Fluegeman that Discoaster mohlerii specimens were reworked into this member. Finally, numerous high-resolution studies have focused on the late Paleocene through early Eocene interval preserved in the deep sea around the world, and none have found evidence for a hyperthermal between the PETM and the ETM2. (e.g., Cramer et al., 2003; Zachos et al., 2010). The recognition of a negative carbon isotope excursion and thus a hyperthermal as described in the manuscript is therefore inconsistent with an age in between the PETM and ETM2 as suggested by Fluegeman.

Sincerely,

Also on behalf of all authors,

Appy Sluijs

The occurrence of the planktic foraminifers Morozovella subbotinae and M. velascoensis (Mancini and Oliver, 1981) restrict the age of the Bells Landing Marl to the time

interval spanning the latest Paleocene (Zone P5 of Wade et al., 2011) to the earliest Eocene (Zone E2). The occurrence of Pseudohastigerina wilcoxensis would suggest an earliest Eocene age (Wade et al., 2011). However, diachronicity between the GCP and Africa, where the range of this species was calibrated, cannot be excluded. Mancini and Oliver (1981) note that P. wilcoxensis likely evolved from Planorotalites chapmani during the Late Paleocene, partially based on the "somewhat atypical" specimens of P. wilcoxensis found in lower Tuscahoma marls. If P. wilcoxensis evolved in the study region it may not be surprising if its first occurrence was earlier here than in Africa. Indeed, its first occurrence was previously reported to be diachronous with latitude (Pardo et al., 1997). Moreover, Gibson et al., (1982) and Siesser (1983) determined that the Bells Landing Formation represents the late Paleocene (calcareous nannofossil zone NP9). This is based on the occurrence of Discoaster multiratiatus and the combined absence of Tribrachiatus spp., and Rhomboaster spp., which excludes an age younger than NP9. Both Tribrachiatus and Rhomboaster are heavily calcified genera that are resistant to dissolution, making it unlikely that preservation accounts for their absence. To our knowledge, there is no report of a nannofossil species in the Bells Landing Marl that would suggest an age younger than late Paleocene (Zone NP9).

Above the Bells Landing Marl, the Tuscahoma Fm, particularly within the studied region (Fig. 1), is composed of mudstones with intermittent lignites representing estuarine and lagoonal environments (Ingram, 1991), with little to no carbonate and no calcareous microfossils (Gibson and Bybell, 1994). The uppermost beds of the Tuscahoma Fm yield brackish to fresh water palynomorphs, notably pollens and spores of late Paleocene affinities (e.g., Frederiksen et al., 1982; Frederiksen, 1998; Harrington, 2003). Collectively, we agree with the published work that the available information indicates a Paleocene age of the Tuscahoma formation (e.g., Gibson and Bybell, 1994; Harrington, 2003; Beard, 2008).

Siesser (1983) determined that the Bashi Marl represents calcareous nannofossil zone

NP9, perhaps NP10. The NP9 designation for the Bashi Marl is based on the co-occurrence of Discoaster multiradiatus and D. mohleri, which is stated to be restricted to the late Paleocene. However, Eocene occurrences of D. mohleri are known from Demerara Rise, South Atlantic (Mutterlose et al., 2007), Walvis Ridge, South Atlantic (Monechi and Angori, 2006), and Mexico (Garcia-Cordero and Carreño, 2009). The last occurrence of this species is not well-constrained. Gibson et al. (1982) dated the Bashi Marl as NP10 based on the occurrence of Tribrachiatus contortus and T. bramlettei, both of which are restricted to NP10 in the earliest Eocene (Vandenberghe et al., 2012).

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