Clim. Past Discuss., 11, C1483–C1487, 2015
www.clim-past-discuss.net/11/C1483/2015/

Climate of the Past Discussions

Interactive comment on "Constraints on ocean circulation at the Paleocene–Eocene Thermal Maximum from neodymium isotopes" *by* A. N. Abbott et al.

Anonymous Referee #2

Received and published: 26 August 2015

This paper presents εNd data measured on leachates of samples from 7 cores which span the Paleocene-Eocene Thermal Maximum and surrounding time periods. The paper uses this data to investigate the role that changes in ocean circulation played in the PETM. As such it addresses a question within the scope of this journal, and given the size of the new data set I believe this paper is appropriate for publication in Climate of the Past; however, there are a number of points which I think the authors should address in order to make their results and interpretations clearer for the reader.

Major comments include:

1. The comparison of the new leachate data presented in this study with published

fish debris data from the same cores could be improved. It is unclear which depths (if any) have both fish debris and leachate data. If there are sufficient depths with values for both archives then a cross plot would seem the best way to compare leachate and fish debris data. If there is little data from the same depths then this won't be possible. In that case any apparent offset could be an artefact of sampling resolution, this may be the "higher-order variability" (p 2563 line 21) the authors refer to, but this could be elaborated upon. Although their results do not appear to show such a significant offset as has been reported by others (Elmore et al. 2011; Wilson et al. 2013), the authors should mention that decarbonated leachates have been shown to be susceptible to detrital contamination.

2. If the fish debris versus leachate question is dealt with separately using a cross plot then Figure 2 can focus more directly upon the paleoceanographic interpretation of the data. If the authors believe that both fish debris and leachates are predominantly a seawater signal then I suggest the two data sets could be made into composite records for each core in Figure 2 (but keeping the hollow/filled symbol key for leachates/fish debris suggested in minor comments below). At present the existing fish debris data is under-utilised and the variability in the data across the PETM is not fully captured by not connecting the two data sets. If the authors do not wish to connect the two data sets in case of a possible systematic offset between the two, a dashed line of the same colour connecting only the fish debris would be helpful.

3. The connection between the data sets in Figures 1 and 2 and the circulation schemes presented in Figure 3 could then be made much more explicit by either colour scaling the core location dots in Figure 3 with the εNd values for each time interval with a single scale bar on the side, or alternatively writing the εNd value next to each core site. This would also help to clarify if there are time intervals where some cores have no data, for example site 213 prior to the PETM. At present the reader is made to work quite hard to establish how the authors arrived at the circulation schematics shown.

4. Although they argue in the conclusion that the Paleocene-Eocene ocean should not

be compared to a conveyor-belt-like circulation regime (p2569 line 21), some consideration should be given to the modern circulation regime and the resultant εNd values. In particular the fact that there is communication between the Atlantic, Southern and Pacific Oceans in the present day yet they display isotopically distinct values (Goldstein & Hemming 2003). Therefore, different εNd values in different ocean basins alone cannot rule out water mass exchange between the basins.

Minor comments:

Although they are listed in Table 1, no mention of the paleodepths of each site is made in the text. It is worth explicitly stating that the sites were all estimated to have been at similar paleodepths which means they are not sampling water masses at different depths, especially for core sites within the same ocean basin.

p 2562 Section 2.3 Line 21. The authors could state that typical corrections made for this time period are small, approximately 0.5 ε units, thus can be neglected as they have done (Thomas et al. 2003).

p 2563 section 3.2 line 11. Is site 1051B really in the eastern Atlantic? It appears to be western Atlantic in Figure 3.

P 2568 lines 11-13 The authors argue that similar eNd shifts to those seen at site 1220 in the Pacific are not seen in the South Atlantic, however they have no leachate data from the corresponding time period (Figure 2). The only data in that time period is the published fish debris data which does potentially show a shift immediately prior to the PETM although it may not be coincident with the Pacific shift.

Table 1: It should be stated somewhere on the table that these are DSDP/ODP/IODP cores; although this is stated in the text, putting it at least in the table caption would make it clearer to the reader.

Table 1: Rounding the coordinates to the nearest minute would be easier to read. Modern depths could also be rounded consistently (to the nearest metre).

Figures 1 and Figure 2: Although the errors are stated in the text, average error bars should be included somewhere on all εNd plots. This would make it easier for the reader to interpret whether any offsets between records from within the same ocean basins are significant.

Figures 1 and Figure 2: It would make it simpler to interpret these figures together if each core a had consistent colour/symbol between the two figures.

Figure 2: It would be easier to interpret the records if the same pattern of filled symbols for fish debris and hollow symbols of the same colour for leachates were adopted for each core as is done in Figure 1.

Typographic errors

p 2560 line 15 ". . .at the PETM, Specifically. . ." should presumably be: ". . .at the PETM. Specifically. . ."

References:

Elmore, A.C. et al., 2011. Testing the extraction of past seawater Nd isotopic composition from North Atlantic deep sea sediments and foraminifera. Geochemistry Geophysics Geosystems, 12(9), p.Q09008.

Goldstein, S.L. & Hemming, S.R., 2003. Long-lived Isotopic Tracers in Paleoceanography and Ice Sheet Dynamics. In Treatise on Geochemistry. Elsevier Science Publishers B.V., pp. 453–489.

Thomas, D.J., Bralower, T.J. & Jones, C.E., 2003. Neodymium isotopic reconstruction of late Paleocene-early Eocene thermohaline circulation. Earth and Planetary Science Letters, 209(3-4), pp.309–322.

Wilson, D.J. et al., 2013. Reactivity of neodymium carriers in deep sea sediments: Implications for boundary exchange and paleoceanography. Geochimica et Cosmochimica Acta, 109, pp.197–221.