

Interactive comment on “Cretaceous Oceanic Anoxic Events prolonged by phosphorus cycle feedbacks” by Sebastian Beil et al.

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This paper aims to illustrate the potential role of P-cycle feedbacks in prolonging OAE 1a and OAE 2. The paper contains useful data and some excellent diagrams but is rather densely written, skips over some important problems, switches tenses a lot when describing geological phenomena, and ignores some relevant literature. The fundamental point that the low P/TOC ratios in the OAE sediments points definitively to phosphorus recycling (and nutrient re-supply to planktonic biota) during these events tends to be easily lost. The issue of P recycling during OAEs has, of course, been made previously, including from a modelling perspective (e.g. Mort papers; Nederbragt et al). The value of the account lies in the fact that the sections described are stratigraphically very expanded and give superb detail as to changes in the carbon cycle before, during

C1

and after OAEs.

Abstract and beyond: the statement that the evolution of the carbon-isotope curve of the two OAEs, as classically defined, shows remarkable similarities needs to be qualified. The defining characteristic of OAE 2 is the overarching positive excursion; for OAE 1a it's the negative excursion. Many OAE 2 sequences (e.g. Eastbourne, UK) show no negative excursion, although its absence is probably due to the presence of the sub-plenus erosion surface in the case of the English section. More needs to be made of all this because the apparently more stratigraphically complete Tarfaya record of OAE 2 clearly offers a unique perspective. The New Zealand record of Gangl et al. (EPSL, 518, 172–182) and Japanese record of Nemoto and Hasegawa (Palaeo-cubed, 309, 271–280) may also show this negative excursion but it is certainly not everywhere apparent. As regards OAE 1a, as illustrated in Fig. 4, the main positive excursion extends higher than the C6 segment (i.e. post OAE 1a - unless C6 is extended higher in the section). Do we need a total redefinition of OAE 1a, as implied here? If so, all of this needs to be made clear as perhaps we have been biased by the records of the Cismone and Piobbico cores. But there is a problem: where are the abundant black shales that correspond to the C6 and C7 relatively heavy carbon-isotope segments, given that the original OAE definition is rooted in the quasi-coeval organic-rich record on a global basis?

Line 21: not clear which events are being referred to with 'respectively'

Lines 23–25: nutrients may have been supplied by basalt–seawater interaction, probably involving LIPs. (Mentioned later in the text but not here)

Line 55: cite original paper by Scholle and Arthur (1980)

Line 66: Are these Mort papers the appropriate references for discussion of transgression? See Jenkyns (1980)

Line 92: rewrite as: 'A variety of phosphorus species are discriminated against in these

C2

sediments.

Line 98: change 'In contrast' to 'By contrast'

Line 131: hyphenate 'intermediate-resolution' to read as written here

Line 164: do you mean nannofossils and planktonic foraminifera? 'Shells' rather implies macrofossils.

Line 189: hyphenate 'metal-free' to read as written here

Line 271: change 'In contrast' to 'By contrast'

Line 280: state in which segments of the OAE 1a record the cooling events have been identified. Do they conform to those illustrated in Jenkyns, 2018 (Phil .Trans Roy. Soc.) from multiple localities, namely: C3, C4 and C6? Which cooling events in the OAE 2 record correspond with the Plenus Cold Event? Are these multiple events registered anywhere else? Do they relate to the fact that Tarfaya was a palaeo-upwelling site with upward movements of cooler water or are they global? The largest positive oxygen-isotope shift (Fig. 2) seems to predate the rise in carbon isotopes: i.e. before major global carbon burial was registered, which is not as stated in the text (line 284).

Line 318: it would be worth looking at the C-segment durations given by Scott , 2016: (Barremian–Aptian–Albian carbon isotope segments as chronostratigraphic signals: numerical age calibration and durations. *Stratigraphy*, 13, 21–47) to see how they compare with your data.

Line 329: hyphen not necessary in 'orbitally tuned'

Lines 343–345 and Fig. 2 and Fig. 5: it might be useful to label the features on the OAE 2 carbon-isotope profile (a,b,c,d), as illustrated by Voigt et al., 2017, *EPSL*. 53, 196–210.

Line 465: 'prevail' - this is present tense and is but one example where past tense should be used for geological narrative. There are many instances of this error in the

C3

text. It's also important to maintain clarity when moving from description of an isotope curve to inferences about the environment.

Line 500: compare with the durations given by Scott (see above)

Line 504: change 'In contrast' to 'By contrast'

Line 552: change 'In contrast' to 'By contrast'

Lines 579: Mention needs to be made of the key paper by Handoh and Lenton, 2003 (*Global biogeochemical Cycles*, 17, 1092, who also discuss the cycling of phosphorus to maintain productivity during OAEs. This paper draws on the important papers of Föllmi (*Geology*, 1995, 23, 503-506; *Earth-Science Reviews*, 1996, 40, 55–124) that discuss the long-term stratigraphy of phosphorus in the stratigraphic record.

Line 581: say how synthesized from atmospheric nitrogen. This will involve a brief discussion on cyanobacteria and papers by Kuypers et al. (*Geology*, 2004), and others

Page 615: is 'largest' the right word? Most significant?

Line 622: given that the durations of the carbon-isotope plateau phases are so different, is their causality different as well? We know that the plateau phase of OAE 2 corresponds with maximum organic-carbon burial, at least in the Tethys–Atlantic region - but there is no such evidence for OAE 1a (except possibly Shatsky Rise). So what is going on?

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