

Interactive comment on “Ecological response to collapse of the biological pump following the mass extinction at the Cretaceous-Paleogene boundary” by Johan Vellekoop et al.

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Received and published: 22 August 2016

Dear Editor, I have now read the manuscript by Vellekoop et al. “Ecological response to collapse of the biological pump following the mass extinction at the Cretaceous-Paleogene boundary”. The manuscript presents the first ecological data concerning marine biota disruptions following the K/Pg mass extinction from a new, continuous section spanning the K/Pg boundary in the central-western Tethys. The manuscript presents an original combination of biotic proxies in what it couples records of benthonic and planktonic marine organisms (benthic foraminifera and dinocysts) which did not suffer extinctions at the K/Pg boundary but overcame this dramatic crisis fairly well. All these aspects combined are valuable and can provide new insights on the mecha-

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nisms which allowed the survival of some groups and brought to the extinction others. To achieve this aim, however, the manuscript needs, in my opinion, substantial major revisions. My main concerns regarding this manuscript are:

Research approach: it should be kept independent from the main models (e.g. Living Ocean model, see comment below) concerning the K/Pg marine biological crisis. The already known models must not be used to interpret the data, differently the reasoning gets circular preventing any new knowledge from emerging.

Benthic foraminiferal analysis: the benthic foraminiferal dataset needs to be improved. As it is right now it can provide but little information. See detailed comments below.

Comparison with benthic foraminiferal records from other sections: it cannot be done when these records are from different size fractions (125 μm or 63 μm). Either the authors stick to the 125 μm (which I do not recommend) and compare their record with the few others available within the same size fraction, or they change into the 63 μm (which I recommend), and can then make comparisons with the other 63 μm records available (included all the records from oceanic cores). However, as general suggestion, I would say the authors should focus much more on their own original data and on what new they can add, rather than on comparisons with other records.

Main Comments:

1. Title: The model arguing for a global collapse of the biological pump following the mass extinction is controversial, and still not univocally accepted (see Thomas, 2007, Birch et al., 2016). I suggest to the authors to remove it from the title.
2. Introduction: Pag. 4-L9-13: this paragraph states the approach of this paper which in my opinion is conceptually wrong. You don't do carry out a new research to place it “in the context” of what it is already known or thought to be known, but to bring in new knowledge, improve, edit or discard what's already known.
3. Methods: The benthic foraminiferal dataset should be improved in order to provide

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compelling environmental and ecological reconstructions. Suggestions to improve the dataset: - The authors studied the size fraction larger than 125 μm for the benthic foraminiferal analysis. This can lead to miss important ecological information as disaster taxa and stress tolerant opportunistic taxa which bloom during environmental stress are often smaller (e.g., Boscolo Galazzo et al., 2013; Giusberti et al., 2016). To me the use of the >63 μm size fraction would have been more appropriate for this study. See for instance Thomas (1990), Alegret et al. (2003), Alegret and Thomas (2007; 2009). The study of the smaller size fraction might for instance reveal peaks of small opportunistic infaunals, challenging the current environmental interpretation. Ideally the counts should be improved counting the whole >63 μm size fraction. I understand that at this stage this would imply the re-study of the whole sample set. However, the authors should at least re-count same samples using the whole >63 μm size fraction in order to check that important ecological information/patterns are not missed in the critical stratigraphic intervals with the use of the larger size fraction. These additional data should be included as a figure in the paper. - To estimate benthic foraminiferal accumulation rates (BFAR) in on-land sections can be somewhat difficult as sample dry bulk density values are difficult to measure. In this work average density values derived from literature are used. For this reason, I advise caution with the use of these BFAR data to reconstruct export productivity changes, and I recommend BFAR is not used as a key parameter to interpret benthic foraminiferal faunal changes. Besides, they calculated BFAR using the number of benthic foraminifera/gr sediment for the >63 μm size fraction while their assemblage counts have been done in the >125 μm size fraction. This must be changed for consistency as faunal patterns in these two size fractions can be quite different. - Benthic foraminiferal counts have been made by counting 300 specimens for each samples. This is a standard counting threshold widely used in benthic foraminiferal quantitative studies. However in this specific case I encourage the use of species-specimens plots to establish the most suitable number of specimens to count (see Thomas, 1990). The use of species-specimens plots allows to ensure that species diversity is well represented. In an outer-neritic upper bathyal site species

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diversity might be higher than in the deep sea settings, where the standard average of 300 specimens is usually employed. Since the relevance of diversity changes among benthic foraminifera for this study I would perform a species-specimen plot for each of the 4 intervals recognized in order to assure species diversity is well represented.

4. Results: please mention in the text (1) the number of samples along with their stratigraphic position for each of the recognized intervals (benthic foraminifera); (2) thickness and approximate duration of each interval.

5. Discussion: -Paragraph 5.1: As highlighted by the review paper of Culver (2003) and by Thomas (2007) there is no agreement regarding the ecological meaning of the generally low-diversity benthic foraminiferal assemblages occurring just above the K/Pg boundary. Even though similar changes between the % of epifaunal and infaunal species can be recognized between different records, such % changes can have different environmental meanings in different environmental settings. So I suggest caution in drawing Tethys-wide environmental scenarios based on changes in the proportion of epifaunal-infaunal species. -Paragraph 5.2.1: In this paragraph the authors seem to use the Living Ocean model (D'Hondt and Zachos, 1998) to explain their data. In my opinion they should first provide a sound interpretation of their dataset and then, argue whether their dataset fits (or not) with the main models used to explain the K/Pg $\delta^{13}\text{C}$ shift. Further, which new contributions brings their own data to a further development/understanding of these models? In my opinion this is an aspect which is currently not sufficiently addressed in the paper. -Paragraphs 5.2.2&5.2.3: As for what concern benthic foraminifera, the work cited in these paragraphs used different size fractions for their studies (either >63 μm or >125 μm) so direct comparisons among datasets are so far not possible.

6. Conclusion: The conclusion paragraph should be focused on summarizing the findings of the paper. Personally I think it should be rewritten highlighting the paper's data and their meaning. This is first of all a paper which presents new ecological data from a new section spanning the K/Pg boundary, it is not a review paper.

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7. Figures 2-6: please add the number of samples studied and their stratigraphic position. Figure 6: please add the duration of each interval like in the previous figures.

Minor remarks: Abstract: Pag. 1-L26: beginning of the line, please insert "in" after comma. Text: Pag. 2-L13: "toward" repeated twice. Pag. 4-L11: "records" repeated twice. Pag. 5-L22: please delete "refractory".

Interactive comment on Biogeosciences Discuss., doi:10.5194/bg-2016-275, 2016.