

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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Vellekoop present new dinocyst and benthic foraminiferal analyses from K-Pg boundary section from northwestern Turkey, and assess changes in community composition in terms of the response of the ocean's "biological pump" to environmental change that drove this mass extinction. The results are consistent with studies from other Tethyan neritic to upper bathyal sites, indicating a continuation or even enhancement of primary production but a reduction in food supply to benthic environments in the aftermath of the extinction. These results are consistent with the "living ocean" hypothesis.

The authors do a good job differentiating between the strength and the efficiency of the biological pump. In the modern ocean, strong biological pumping (i.e., high export

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production) occurs in regions of strong vertical mixing or upwelling, and these areas tend to have residual surface nutrients. This means that they have inefficient but strong biological pumps. This inefficiency is reflected in a reduced gradient between surface and deep in $\delta^{13}\text{C}$. Oligotrophic regions of the ocean, like the subtropical gyres, have low export production but highly efficient use of nutrients, and this is reflected in a large gradient in $\delta^{13}\text{C}$. Thus, geographically at any particular time, one would expect that export production is inversely reflected in the $\delta^{13}\text{C}$ gradient. Understanding this helps understand how the collapse of this gradient at the K-Pg boundary doesn't necessarily imply a reduction in the strength of the biological pump. A good citation for this is Hilting et al., 2008, "Variations in the oceanic vertical carbon isotope gradient and their implications for the Paleocene-Eocene biological pump", *Paleoceanography* 23: doi:10.1029/2007PA001458.

I do have some suggestions for revision:

* The authors don't really have any direct evidence that the biological pump collapsed at their site, because they have no benthic $\delta^{13}\text{C}$ values. If they could generate these data their story would be further substantiated.

* The collapse of the biological pump should indeed lead to enhanced nutrient recycling into the photic zone and should also expand and shoal the oxygen minimum zone. The authors might want to consider this in light of their interpretations of indicators (or lack thereof) of dysoxia at various sites.

* I think the contrasting behavior in the open ocean (deep sea), e.g., page 12, paragraph beginning line 24, can be understood by the relative resistance of the more recalcitrant organic matter that the deep sea usually gets anyway to more intense surface-ocean recycling with the collapse of the biological pump. In other words, the deep-sea benthic foraminifera continue to receive recalcitrant organic matter at barely diminished rates despite the collapse of the biological pump.

Page 1, Line 16: I think the "now unequivocally shown. . ." comment about impact as

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the cause of the extinction should be removed; the comment is irrelevant to the current manuscript and might be considered by some as a "pot shot" at the volcanic origin idea. The way this same idea is put on line 31 is better "It is now commonly accepted. . ."

Page 2, Line 12: My modeling did not suggest that "productivity had to continue nearly unabated . . . (Kump, 1991). Rather it showed that burial had to continue nearly unabated. Burial could have been in shallow water or on land, where the required productivity would not impact the ocean's vertical carbon isotope gradient. Primary productivity certainly COULD have continued unabated, but export productivity had to have been diminished (unless the whole ocean became destratified and well-mixed).

Line 14: "persistence"

Line 22: remove "to" after "from the photic zone"

Page 3, Line 17: "changes in, for example, temperature . . ."

Page 4, line 14: Might be good to foreshadow the main conclusions at end of this paragraph.

Page 5, line 18: "quantitative" ?

Line 22: indicative "of"

Page 6, Line 1: data "were"

Page 12, line 22: some of the effects of the impact, like the trace-metal poisoning, could have been relatively long-lived. See for example Jiang et al. Nature Geoscience 3, 280 - 285 (2010).

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