Biogeosciences Discuss., referee comment RC1
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Comment on bg-2021-230

Anonymous Referee #1

Referee comment on "Late Neogene evolution of modern deep-dwelling plankton" by Flavia Boscolo-Galazzo et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-230-RC1, 2021

This is a truly excellent paper. It represents a major advance in the understanding of the evolution of Neogene planktonic foraminfera and calcareous nanoplankton over the last 15 million years. It usefully explains, for the first time, the evolutionary diversity increases in numerous lineages that lead to the modern depth and oceanic distributions of these important planktonic groups. These groups are an important component of the modern ocean plankton and play a significant role in marine biogenic productivity. The paper is well written and easy and enjoyable to read. It builds upon the earlier (2021) paper by Boscolo-Galazzo et al. Essentially the paper demonstrates, using large new suite of quantitative taxonomic and geochemical data, that the deep-dwelling planktonic communities evolved as an important component of oceanic planktonic during the later Neogene (after about 7.5 my). This, in turn, played a vital role in increased planktonic biomass production and its expanded depth distribution in the oceans and related processes of vertical organic carbon transfer via marine snow.

The paper also convincingly argues that the development of the deep planktonic ecological niches (i.e. new deep-water ecogroups of planktonic foraminifera and calcareous nanoplankton) were driven by palaeoceanographic processes related to late Neogene oceanic (global) cooling. This sequential cooling stimulated oceanic circulation that increased organic carbon (nutrients) export production to the deep sea, increased oceanic oxygen levels, and enhanced light penetration into deeper waters, all of which stimulated the vertical biological pump that favored the evolution of these deep-water niches.

The paper, as presented, seems to require little change, but I suggest that the arguments can be strengthened by reference to some earlier contributions that provided a basis for this break-through contribution.

- The work built upon a significant amount of earlier work that identified and summarized the phylogenies of many of the foraminiferal lineages analyzed in the current work. For example, Kennett and Srinivasan (1983) graphically illustrated phylogenetic lineages of planktonic foraminifera "Neogene Planktonic Foraminifera- a phylogenetic Atlas"; Hutchinson Ross Pub. Co. These include numerous deeper water lineages discussed in this paper. Also, the characteristic morphology of the taxa are shown in SEM images- a useful resource that helps with the understanding of the evolutionary relationships. Otherwise, most readers will not be familiar with planktonic foraminiferal morphology and the names alone will not click so much from an evolutionary perspective.

- A crucial part of the hypothesis presented in this paper is that the overall palaeoceanographic process was ultimately driven by global cooling during the late Miocene and later. The evidence for this is not an analytical part of this paper, but instead is provided by reference to previous investigations. However, mentioned references in support of this cooling is limited to just two contributions: Crichton et al (2020) which is largely a modeling effort, and Cramer et al. (2011) (By the way, this reference is absent in the reference list of this paper). There is compelling evidence for Neogene cooling earlier than 7.5 ma which is acknowledged in the statement as " a possible acceleration of global cooling" but this may well have been a distinct climatic threshold event. Evidence for late Miocene cooling has long been known, presented, and discussed in the literature. For this reason, this contribution would be considerably strengthened by acknowledging this. There are numerous examples, but I am most familiar with the evidence gained from studies of sediment cores obtained as the result of major deep sea drilling expeditions in at least three parts of the world ocean. Specific mention of late Miocene cooling is summarized in the following three references (although there are others that the authors might prefer to mention):

Kennett and Von der Borch (1985). Southwest Pacific Cenozoic Paleoceanography. Initial reports of DSDP Project, Vol 90, p 1493.

Kennett and Barker (1990). Latest Cretaceous to Cenozoic Climate and Oceanographic development in the Weddell Sea, Antarctica; an Ocean Drilling Perspective. Proceeding of the Ocean Drilling Program, Scientific Results. Vol. 113, p 937.

Kennett and Exon (2004). Palaeoceanographic Evolution of the Tasmanian Seaway and its Climatic Implications: in Geophysical Monograph Series 151, American Geophysical union, p 345.

All of these contributions also present evidence that this late Miocene and younger global cooling stimulated ocean planktonic biogenic productivity through stimulated ocean overturning circulation. The authors may prefer to reference other such contributions, but in any case, these would strengthen their arguments.

- The wording on a number of the figures is quite small and difficult to read (e.g. Figs 2,3,4,7). It may be possible to make these larger without spoiling the quality of the figures. This is not crucial but something to consider.

- Minor points:

Line 25- during the latest Miocene…

Line 60 - In contrast to planktonic foraminifera…

373 - …. impacts the relative abundance between…

421-422- clarify and simplify this important sentence

427-428- The sentence is clumsy and needs improving

430-433- sentence is too complicated and needs rewriting

437-438- Simplify the early part of the sentence

444- make new sentence, i.e. break up this long sentence.

456- what are "foraminiferal prays"?

- Check the reference list for completeness.

- Consider a new title for this paper, since the current one is too general and really does not reflect the importance and focus of this contribution. Example: "The Late Neogene Development of Deep-dwelling Planktonic Ecogroups".