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Climate of the Past Discussions

Interactive comment on "Long term trends in aquatic diversity, productivity and stability: a 15,800 year multidecadal diatom study from Lake Baikal, southern Siberia" *by* Anson W. Mackay et al.

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1. In the description of the lake, it would be helpful to say something about the primary producers. Specifically, what proportion of the primary producers are diatoms, and how is diatom productivity related to overall primary productivity? What are the primary controls on diatom or primary productivity in the modern lake?

Authors Response: âĂć We will add the following sentences to the section "Study site", with appropriate references.

"Diatoms comprise between 50-90% of phytoplankton biomass during the Spring bloom under ice and after ice break-up (Popovskaya et al. 2015; Panizzo et al. 2017), that contributes a significant proportion of overall annual primary productivity (Popovskaya 2000). With the seasonal onset of summer warming and surface water stratification, diatoms decline in importance, and are replaced by non-siliceous autotrophic picoplankton (Fietz et al. 2005; Belykh et al. 2006). During autumn turnover, a smaller diatom bloom once more dominates primary production. Nitrogen and phosphorus co-limit photic zone productivity in Lake Baikal (Satoh et al. 2006; O'Donnell et al. 2017), with rates of deep-water nutrient supply increasing markedly since the mid 19th century (Swann et al. 2020)."

2. Lines 376-78: It's not clear why you focus only on half of the Holocene Bond Events – why not the intervening ones? If there is a diatom response only to the few Bond Events that you chose here, but not the others, this is worthy of a comment or speculation about why this might be so. Also, these dates are different from those originally proposed by Bond (e.g. he has 5.9 and 4.2 ka, whereas you list 5.2ka) – are these recalibrated? Please clarify.

Authors Response âĂć The reviewer makes a good point here, in that by focussing on only selected Bond Events we are in effect biasing our interpretation towards only events where we have a coincident signal. As we have been afforded the opportunity to re-look and reanalyse our data, based on other reviewers comments, we will instead focus on known periods of global climate change (both abrupt and slow), so that we can investigate relationships between the different biological response variables under different climate scenarios. We will therefore focus our efforts on the more variable (i.e. the Bølling-Allerød interstadial and the Younger Dryas stadial) and more stable (the mid- Holocene) climatic periods. This also takes away from any dating uncertainty about when Bond events occurred in the record.

3. Line 395-7: So what does it tell us about the environment or about the diatom community if the community has high species richness but low N2 diatom diversity?

Author's Response âĂć The time period indicated here is during the latter stages of Termination 1, where a peak in diatom richness (N0) is coincident with a peak in diatom N2 diversity, followed by drops in both. What we can say is that higher diatom richness closely follows the patterns in total benthic diatoms, while in general N2 diversity reflects dominant taxa in the record. As we are now presenting diversity data just for the plankton in Lake Baikal (see comment #5 below), we expect richness and diversity relationships to change somewhat from the original manuscript.

4. Line 400: I'm confused. I thought lines 383-384 say the pre BA community has moderately high species richness, but here you say the flora persists with low richness. Please clarify

Author's Response âĂć Line 383-384 refers to a comparison of diatom richness between Termination 1 and the Holocene, for which there was no significant difference between the two time periods, with N0 = 22.7 and 24.1 respectively. In Line 400, we agree that our use of "pre- Bølling diatom flora persists, with concomitant low richness" is only correct for part of the Termination 1 record, as clearly there is a short-lived peak in richness as well. We have edited Lines 399-400 and have deleted "...with concomitant low richness"

5. Lines 401-402: Would it make more sense to only consider planktic diatom species richness and diversity? Or also include diversity changes simply among the planktic group? Changes in diversity that are a result of mixing of littoral with planktic communities (taphonomic processes) that didn't really live together is very different from changes of diversity within a single community of species that are actively interacting and competing for resources.

Author's Response âĂć We agree with the reviewer's comments here, and will calculated diversity and richness based on diatoms identified to be planktonic from the key Lake Baikal flora (Popovskaya & Likhoshvai 2011), to simplify these interpretations, and to reflect that the fact that benthic diatoms occupy completely different habitats are

so are not competing for the same resources.

6. Line 420-422: This raises the general issue about how changes in seasonality might affect diversity, especially given that the diversity of a sample is integrating over multiple decades. If you simply lengthened or shortened the summer season, what would happen to diversity? I'd like to see a bit more development in the manuscript about the impact of seasonality on diversity, etc.

Author's Response âĂć Our original interpretations were based on diversity records of combined planktonic and benthic diatoms. With reanalyses of diversity measures based only on planktonic and tychoplanktonic taxa, our interpretations will change somewhat throughout the discussion. However, we take on board the reviewer's comment re. the influence of seasonality, and will certainly consider further.

7. Line 467-482: I don't think this description of what occurred globally is needed – stick to the global driver (AMOC) and the regional manifestation of climate that drove aquatic change.

Author's Response âĂć We agree, and we will make this and other sections (which were overly focussed on selected periods of abrupt change coincident with Bond events) much more succinct, or we will remove them altogether.

8. Conclusions: I wonder about adding a few thoughts or speculations about how these observations of patterns in Lake Baikal might compare with paleolimnological observations/ reconstructions made in other regions or from other kinds of systems about diatom resilience to natural climate variability (for example, Jovanovska et al. 2016; Benito et al. 2019). There have been a few recent papers out on this. This would emphasize the broader significance of the results.

Authors Response âĂć These are interesting suggestions, and will consider how best to incorporate them in the conclusions.

9. Technical comments

Authors Response âĂć All three amendments have been made

References used in this report, and now added to the manuscript

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