Climate of the Past Discussions

Clim. Past Discuss., author comment AC2
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Reply on RC2

Jakub Witkowski et al.

Author comment on "North Atlantic marine biogenic silica accumulation through the early to middle Paleogene: implications for ocean circulation and silicate weathering feedback" by Jakub Witkowski et al., Clim. Past Discuss., https://doi.org/10.5194/cp-2021-50-AC2, 2021

Reviewer comment: In general, it would be helpful for the authors to discuss in more detail the conditions in which diatom productivity is limited by silicon rather than another nutrient(s). As the authors point out, productivity can be limited by silicon supply from weathering, supply from circulation/upwelling, OR the (lack of) other nutrients. It would also be helpful to see a discussion of whether/how we know that diatom productivity is limited in the long term/large scale by silicon supply from weathering, rather than by a combination of these other factors.

Response: This issue is actually the focus of another paper in preparation by the lead author. As already remarked in response to the comments by the first reviewer, a broader discussion on factors limiting diatom productivity will be included in the revised manuscript, as requested here.

Reviewer comment: Figure 2. Please label/identify the fit lines (assuming that's what those are) in the figure caption.

Response: The heavy red lines represent smoothed opal concentration (Figure 2A) and opal flux (Figure 2B) curves. These were derived from LOESS regression. By mistake, the span of the LOESS smoothing procedure was not included in the relevant figure caption. The figure caption will be updated accordingly in the revised manuscript.

Reviewer comment: Section 3.2 How significant are these correlative relationships given that the bioSiO2 fluxes are based on 1) smoothed sedimentation rates and 2) interpolated DBD measurements? I'm skeptical that these mean much; the authors could certainly make a case for why they do, but they haven't done so thus far.

Response: Our presentation of the opal fluxes follows the convention adopted by Piela et al. (2012, Paleoceanography 27: PA2204). As explained in the text, the reason for smoothing sedimentation rates was to eliminate unrealistic, high-amplitude variations in sedimentation rates between consecutive age model tie-points. The focus of the study is on long-term rather than short-term trends. We argue smoothed datasets are of sufficient resolution for these purposes (i.e. in accurately reconstructing long-term trends in opal accumulation). The robustness of this approach, despite being based on smoothed and interpolated data, is best demonstrated by the multiple regression model, which reproduces the smoothed composite opal flux curve reasonably well. Unfortunately, by

mistake, we have not included the multiple regression model (line 325) output in Figure 2B, despite a reference being made in the text in line 327. This omission will be rectified in the revised version of the manuscript. We will also include a comment on the suitability of smoothed datasets for the purposes of our study.

Reviewer comment: Figure 3. These axis labels won't make sense to many readers – what do the numbers represent?

Response: We agree with the Reviewer. The axes should be labelled more clearly in the revised manuscript.

Reviewer comment: Figure 4. Some of these colors are quite hard to see, especially the light yellows and purples. There are a lot of different things to distinguish, but perhaps these can be a bit darker, or changed for different colors?

Response: We agree with the Reviewer, and intend to differentiate between the colors and line styles in a clearer manner in the revised manuscript.

Reviewer comment: Lines 460-465 The previous paragraph attributes some flux changes to changes in preservation of bioSiO2. Can that be ruled out, or at least shown to be insignificant as it relates to the changes described in this paragraph and the next? If so, the authors should make that case, and if not, should discuss the implications for their interpretations.

Response: A concern regarding preservational issues has also been expressed by the other reviewer. We agree that dissolution could potentially compromise the flux record. We repeat the relevant part of the answer to the other reviewer's comment: silica dissolution occurs in the water column, at the sediment-water interface, and within the sediment, hence the concern whether biogenic opal concentrations and/or fluxes have been compromised by silica dissolution (as stated in lines 45-47, deep-time reconstructions of opal flux are founded on the central premise that opal preserved in the studied sediments has not undergone significant dissolution). Although some attempts have been made (Warnock & Scherer 2015, Continental Shelf Research 102: 1-8), there is currently no reliable, quantitative measure of siliceous plankton preservation in sediments, and the basic indicators of silica dissolution are chert/porcellanite and zeolite (clinoptilolite) occurrences. We have stressed in the text (lines 146-147, 297-298 in the original submission) that these are few in the Blake Nose cores, and that in some intervals diatom preservation can be considered pristine (lines 300-301): hence the assumption that no extensive diatom silica dissolution has occurred, which would lead to preferential preservation of the more dissolution-resistant sponge spicule silica over the more dissolution-prone diatom and/or radiolarian silica.

As both reviewers have voiced similar concerns, we will further expand the discussion on possible silica preservation-related issues in the revised manuscript.

Reviewer comment: Last paragraph of section 4.3 This last sentence highlights the difficulty of using bioSiO2 flux to test the effects of the weathering feedback – changes in flux are just as likely to reflect a change in ocean circulation as they are the weathering feedback. Could the authors try to disentangle these things a little more in this last section?

Response: Further insights into the relationships between opal flux, ocean circulation and weathering feedback could be gained by comparing the opal flux records included in the original submission with published silicon isotope records. A composite $d^{30}Si$ record from the Blake Nose was published by Fontorbe et al. (2016, Earth and Planetary Science Letters 453: 67-77). A comparison between the Blake Nose opal fluxes and $d^{30}Si$ from

Fontorbe et al. (2016) will be included in the revised submission.