

Interactive comment on “Nutrient utilization and diatom productivity changes in the low-latitude SE Atlantic over the past 70 kyr: Response to Southern Ocean leakage” by Katharine Hendry et al.

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1 Response to Reviewer 1

Hendry et al. presented a silicon isotopic record of near- monospecific diatoms from low-latitude SE Atlantic, to explore nutrient utilization since 70 ka. Further this information, coupled with simulation results from mass-balance experiments, provides new insights into the relation of silica cycling to upwelling intensity and silicic acid

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utilization. In fact, an array of publications associated with the study core series (i.e., core GeoB3606 series) has been published; there into several publications (e.g., Shukla and Romero, 2018) have speculated the leakage of silicic acid from Southern Ocean to low- low-latitude SE Atlantic, but it is lack of compelling evidences. Here, the authors, for the first time, provide the silicon isotopic evidence to demonstrate the influences of southern-sourced silicic acid on the diatom growth in the study area. The manuscript was well written with appropriate English usages and normal logics. The conclusions are reasonably made from the presented data, and thus I approve them. I strongly recommend the publication of this manuscript after some minor modifications suggested by me as follow.

We would like to thank the reviewer for their positive comments and will address the minor modifications below.

Specific comments: 1. This manuscript contains some long sentences or long sentences with brackets, such as lines 136-138, 194-196, 219-221, and so on. Although these sentences can express what the authors want to express, their readability is weak. Therefore, I suggest the authors to rewrite them; i.e., separate one sentence to more.

Many thanks for the constructive criticism. We have shortened the sentences as suggested, and have checked throughout the manuscript for readability and typos (changes made on lines 32-33, line 54, and line 220).

2. For the study core, there are enough relevant publications to provide the background on paleoenvironmental and palaeoceanographic conditions. The authors always directly cite this background information without the details. For example, the

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author used the SST as a proxy of upwelling intensity, but they did not explain why the SST can reflect the upwelling conditions in the study area? Not all the readers are familiar with the study area and the study core. Thus, I advise the authors to give some details when citing some important conclusive information from other publications to support their discussion.

We have addressed this concern by adding in further explanation to the proxies as requested. We have not included a detailed explanation of how the Uk-37 alkenone proxy records SST as it is an established proxy that has been used in the region before. The section now reads:

“Changes in nutrient supply as a result of enhanced mixing of the upper-most water column, indicated by reduced SST reconstructions from alkenone archives, are unlikely to fully explain variations in diatom productivity alone. . . The inverse correlation between the relative abundance of the Antarctic diatom *Fragilariopsis kerguelensis* and the alkenone-based SST variations (Fig. 2) in GeoB3606-1 from 70 to 30 kyr suggests a combination of enhanced DSI-rich SO water invasion and stronger wind-driven mixing respectively during this interval of high opal burial. . .”

3. To confirm the leakage of silicic acid from the Southern Ocean, the author combined the information from nutrient utilization, diatom assemblage, upwelling intensity, and so on. It is right! Other way is focus on isotopic tracing. Detailedly the author can also try to compare the silicon isotope ($\delta^{30}\text{Si}$) values among the diatoms (*A. curvatulus*+*C. radiatus*), the waters in the study area, and the southern-sourced waters, based on the silicon isotope fractionation and water mixing. I strongly recommend the authors to have a shot, but I do not guarantee its success.

We agree that it is useful to compare the silicon concentrations and isotopic

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compositions of the diatoms, with likely compositions of the seawater and end-members. We carried out modelling “thought-experiments” to investigate the potential interpretations of the downcore data. The motivation behind the modelling study is now emphasised on line 226 onwards (see also response to reviewer 2).

Technical corrections: Line 9: It is not appropriate to state ‘. . .species-specific $\delta^{30}\text{Si}$. . .’ because the two species *A. curvatulus* and *C. radiatus* were used to analyze the $\delta^{30}\text{Si}$.

This has been corrected, and the sentence now reads:

“Here, we present the first combined $\delta^{30}\text{Si}$ record of two large centric diatoms from the BUS, encompassing full glacial conditions to the Holocene.”

Line 32: In ‘...atmospheric pCO₂...’, the ‘p’ should be italic.

This has been corrected.

Lines 71-72: How the SST changes can account for the diatom productivity?

This has been clarified, see above.

Lines 73-75: Please explain this sentence with some details.

This has been clarified, see above.

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Line 163: Please add ‘.’ in the end of this sentence.

This has been corrected.

Line 170: What is the meaning of ‘. . .of what was available’? Please rewrite it.

This has been clarified. The sentence now reads:

“Not only was *Chaetoceros* production high because of the rate of supply of DSi to coastal waters, but also because they were able to use a high proportion of this available DSi.”

Lines 213-214: Please add the references for ‘. . .consistent with leakage of SO waters at this time into the eastern basin of the South Atlantic’.

Many thanks for this comment. We were unclear that the statement was relating to interpretation of our own data rather than referring to an existing study. We have clarified this, and the sentence now reads:

“We deduce from the $\delta^{30}Si_{CA}$ record that there was strong but variable upwelling of Si-rich waters during MIS4 and MIS3, consistent with an interpretation that SO water leaked into the eastern basin of the South Atlantic at this time.”