

Review Biogeosciences Discussion (March 2023)

Seasonal cycles of biogeochemical fluxes in the Scotia Sea, Southern Ocean: A stable Isotope approach

Belcher et al.

The manuscript „Seasonal cycles of biogeochemical fluxes in the Scotia Sea, Southern Ocean: A stable Isotope approach” authored by Belcher et al. investigates the particulate material (and fluxes) from sediment traps in the northern Scotia Sea from different seasons. The data is of high quality and most aspects of the findings are adequately discussed. However, I have some moderate (major) comments (and a few minor, see below) that needs to be addresses. As this topic fits well into the scope of BGD, I recommend publication after careful revision.

General comment

I think, this is a great dataset, especially the combination of sediment trap data (even from two different depths and seasons) with three different stable isotope systems. However, some parts of the manuscript are a bit hard to read (and I had to re-read couple of times). It rather reads like a long description of result, whereas, in my opinion, some important aspects are missing. The authors never show or discuss in detail about the POC/PN to BSi ratios. This could shed some light on the connection between the silicon and the carbon cycle and especially the carbon drawdown associated to siliceous phytoplankton. Did the authors ever plotted, the $\delta^{13}\text{C}$ and $\delta^{30}\text{Si}$ data against each other (or $\delta^{15}\text{N}$ versus $\delta^{15}\text{Si}$). I think it would be really interesting to see, how they positively and partly also negatively ($\delta^{30}\text{Si}$ with $\delta^{15}\text{N}$) correlate. However, in order to address these issues new figures (e.g. POC/BSi ratios) have to be included in the main text and parts of the result as well as the discussion have to be re-written.

Methods

L145: Please check the coordinates, I guess you mean 54.8036°S and 40.1593°W , the “minus” is used for “South” and “West”. If you state the direction, you do not have to use the “minus”.

Results

L352 Did the assemblages only include siliceous plankton (like diatoms and silicoflagellates)? Or did you also observe other taxa (e.g. dinoflagellates, coccos). Maybe you can add one sentence in the beginning that states that only specific type of plankton was observed.

L344 “..., but shallow and deep traps have $\delta^{15}\text{N}$ of similar magnitude”. Not sure, if I understand the sentence correct. $\delta^{15}\text{N}$ in shallow samples are much higher compared to $\delta^{15}\text{N}$ in deep sediment trap samples. Even though error is large, the highest mean (shallow) is associated with the lowest (mean). I think, this is an interesting observation, that is not sufficiently discussed. What would be the consequences for paleo reconstructions, if we observe difference in $\delta^{15}\text{N}$ with depth.

Table 1: Can you please be more precise on how the error of the mean is derived. How does it include the analytical as well as the replicate error? Is it a 1 sd error or a propagated error? Please provide more information.

L366 The authors list Dictyocha together with all the diatoms, but it is a silicoflagellates. I think, it would be good, if the taxonomic groups (e.g. diatoms, silicoflagellates, dinoflagellates) are given (see also the comment above).

Figures

Figure 3: The figure should be improved. The authors could display the fluxes as boxplots. Please increase the dots size and choose different colors, e.g. open versus filled in black.

Figure 4: It is hard to read the legend and the x, y scale. Could you please increase the font. Can you please specify, what the difference between A) and C) and B) and D). Is this for different seasons. The authors could add an additional legend to make it more clear or edit the figure caption.

Discussion

Please note here also my “general comment” in the beginning. I think the manuscript would benefit from a discussion on elemental ratios as well as a comparison between the stable isotopes. Additional figures could emphasize some parts of the discussion (e.g. L415).

L418 Even though POC and BSi can be closely linked and transfer carbon to the deep, the following statement (L418) has to be rephrased. Not all diatoms have greater densities and higher sinking velocities compared to non-siliceous phytoplankton. Sinking velocities are linked to size (e.g. Bauman et al., 2023) <https://egusphere.copernicus.org/preprints/2022/egusphere-2022-814/>) . Some fast bloomers (small, e.g. Chaetoceros spp.) often does not sink to the sediment (at least not the vegetative cells), as they are already remineralized in the upper water column. Instead, the big “late bloomers”, at the end of a succession (e.g. Coscinodiscus) are often the ones, that are found in the sediments. For a comparison between plankton assemblages in surface water and sediments see also Grasse et al., 2021*.

The authors have information about the biovolume, how does this align with the rest of the data. Maybe they could refer to some of their findings here.

L566 what is the reference for the “exception of one culture study”. What exactly is the isotopic baseline, the authors referring to.

* Grasse, P. *et al.* Controls on the Silicon Isotope Composition of Diatoms in the Peruvian Upwelling. *Frontiers Mar Sci* **8**, 697400 (2021).