

Review Biogeosciences Discussion (June 2023)/2nd round
Seasonal cycles of biogeochemical fluxes in the Scotia Sea, Southern Ocean: A stable
Isotope approach
Belcher et al.

The revised version is significantly improved. However, I still have some minor comments, that needs to be addressed before publication.

L205: The authors give the delta notation only for carbon and nitrogen isotopes, but not for silicon isotopes. I see that the silicon method description is given in another paragraph, but the authors could at least refer to the delta notation, as it is the same for all three stable isotopes (C, N, Si).

L393: Other organisms were observed, but not counted? Do the authors have a rough idea of how much of the sediment trap material was diatoms compared to other (non-siliceous) organisms)? This has some implications for the interpretation of $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$. See also my comment below (L.474). In line 395, the authors say “with a dominance of diatoms”. What exactly does that mean? More than 50% or 90%? The following paragraph only gives information about the diatoms and a few silicoflagellates in each sample. How many dinoflagellates do the authors observe? Does “other” in Figure 4 refers to other taxa, like dinoflagellates? Or other diatoms? Please clarify in the text and the figure caption.

L429: It is very interesting to see the comparison to other flux measurements in the region. However, I miss some kind of interpretation here. Why are POC and BSi fluxes generally higher, but much lower compared to Closset et al. (2015)? Any major changes in the area, that are causing this. Why does the sampling location from Closset et al. (2015) have more than 10x higher fluxes compared to this study?

L469: Please check the sentence. Something is odd. “This could be achieved if cells are large through large”.

L474: I think, this is not even a “broadly” similar trend in Figure 5b. I think the authors should rather discuss, why they do not see a linear trend between $\delta^{13}\text{C}_{\text{POC}}$ and $\delta^{30}\text{Si}_{\text{BSi}}$. Even though the particulate ratios show a strong relation between POC and BSi (except for 3-4 points above the line), the less pronounced or not present relationship in the isotopes can have several reasons.

1. more variation and a higher range in the fractionation factor for $\delta^{13}\text{C}$ compared to $\delta^{30}\text{Si}$ (e.g. Brandenburg et al., 2022¹), which can also include different trophic levels.

¹ Brandenburg, K. M., Rost, B., Waal, D. B. V. de, Hoins, M. & Sluijs, A. Physiological control on carbon isotope fractionation in marine phytoplankton. *Biogeosciences* **19**, 3305–3315 (2022).

2. non-siliceous organisms or organic material (dinoflagellates, microzooplankton). Whereas $\delta^{30}\text{Si}$ is measured mainly in diatoms, $\delta^{13}\text{C}$, as well as $\delta^{15}\text{N}$, is measured in other materials/organisms as well.
3. different remineralization for organic carbon and silicon in the frustule

L476: The authors state that they do not find significant relationships between $\delta^{13}\text{C}_{\text{PON}}$, $\delta^{13}\text{C}_{\text{POC}}$, and $\delta^{30}\text{Si}_{\text{BSi}}$. It would be good if the authors could either show the figures in the supplement or report the r^2 and p levels here for comparison. I am a bit surprised, that the relationship in Figure 5b is significant. Did you include the error? Please check again.

L487: This is more of a general comment. Do the authors take the sinking velocity of particles into account, when discussing the sediment trap data? And if yes, what is the sinking velocity they assume?

L493: “BSi: POC ratios were elevated at the start of productive period 1, suggesting that phytoplankton were heavily silicified.....this statement can only be made if the ratio of siliceous to non-siliceous plankton is not changing over time. Here the authors need to give more information about the amount of dinoflagellates in their samples (see also statement above). And if the statement is “true”, why should a more intense silicification is observed?”

Figure 3: The figure did improve significantly. Maybe it is possible to additionally add the legend to the figure for the deep (red) and shallow (blue) sediment traps.

Figure 4: Maybe the authors could either highlight it in the figure or in the figure caption, how does the assemblage data fit to their different time periods? The abundance data at the end of the sampling campaign (Dec./Jan.) fit within the productive period 2, but the first was already in the winter hiatus.

Figure 5: Please add error bars for the isotope data in 5b.