



EGUsphere, referee comment RC2
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Comment on egusphere-2022-254

Damien Cardinal (Referee)

Referee comment on "Tracing the role of Arctic shelf processes in Si and N cycling and export through the Fram Strait: insights from combined silicon and nitrate isotopes" by Margot C. F. Debyser et al., EGU sphere,
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This work presents a combination of silicon, N-nitrate and O-nitrate isotopes in the Arctic Ocean. The data reported are of high interest for the biogeochemistry community and for oceanographers working in the Arctic, a complex ocean currently undergoing dramatic changes making it still poorly understood.

There have been a series of interesting Si isotopes works in the Arctic the last years, but this new data are welcome because (i) they are from the Fram Strait a key region connecting the Arctic and the Atlantic (ii) the combination of N, O and Si isotopes is particularly appreciated and is a great added value of this work (ii) data are of good quality and cover the whole water column. The paper is generally very well written with in-depth discussion of the multiple processes affecting N and Si biogeochemistry in the Arctic (Pacific vs. Atlantic vs. Riverine sources; shelf processes; primary production and water mass mixing...), so this work certainly deserves to be published in BG. I have some comments, most of them being minor / moderate, listed below. My main suggestions concern (i) clarification of the samples / cruises analysed (ii) the discussion of isotopic signatures in the mixed layer and associated isotopes models which is confusing (including in the way of presenting the results, i.e. Fig. 6 and 8) and/or not fully convincing.

Damien Cardinal

Detailed list of comments

Use dissolved silicon instead of silica

Fig. 1 and Table 1 and §2.1 From all these parts, it is unclear what are the sampling stations for N and Si isotopes from which cruises. There are 4 cruises on table 1, but in the paper isotopes data come mostly from only 2?... Please clarify. In Fig. 1 mention that sea-ice extent displayed is from summer (I guess). There is no mention of N isotope sampling?

L49 This sentence is unclear, since Pacific water are entering the Arctic, so the link with DSi export is not straightforward. Put "net supply of DSi" instead of "net export"? Or rephrase more clearly.

L84 and 87-88, 93 provide st. dev. of these end-members isotopic signatures.

L86 Wrong reference. It should be Fripiat et al. 2018 instead of Fripiat et al. 2011

L115: Samples have been deep-frozen, also for silicic acid concentration? This is not optimal since silica precipitation can take place during deep freezing. Please comment.

L120 Even though it is standard protocol, some reference on methods should be provided for nutrient analyses.

L135 What is the difference between this preconcentration protocol and the one of Reynolds 2006, which has 2 steps too?

Fig. 2 Legend is incomplete, e.g. there is no scale for the T°C panels.

Table 2. Add st. dev. on all parameter water mass averages (e.g. NO₃ and DSi concentrations, N*, Si*, capital delta).

Fig. 4 and 9. Be consistent with the name of the parameter, certainly no silica concentration is displayed here. Dissolved silicon or silicic acid would be much more appropriate.

L253-254. It is claimed here that AW follow more an open system with small fractionation. This is not so obvious from Fig. 6, especially for spring where almost no point fits the open model (grey line) except at low utilization (f close to 1) where both models cannot be differentiated. In summer, data are more consistent with open model, but then, why summer (i.e. more stratified I guess) would be more behaving as an open system? It would have been expected more from spring.

L262-263 The linearity between d_{30Si} et DSi utilization is consistent with an isotopic fractionation highlighted L257, so, why say at the end of the § that it is mixing that control d_{30Si} ? Could mixing behavior be displayed on Fig. 6 to decipher?

Fig. 6 is there a justification having spring and summer displayed in different panels? Since they could represent the same growth season / isotopic system, data could be merged?

Fig. 8. Mention from which depths the data have been taken. Is it only surface samples? Here also, the legend seems to be incomplete / erroneous. In the caption panel, the triangles are different from the graph (e.g. there are different colours, and different shapes with triangle tips up / down not consistent with the main graph). Consequently, I don't understand how the linear trendline for AW has been drawn? How these AW and PSW trendlines compared with Rayleigh models displayed in Fig. 6?

L397 Weird wording here, probably "while" is not needed...

L407 who is Francis???