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Ocean Science
Discussions

Interactive comment on "Silicon pool dynamics and biogenic silica export in the Southern Ocean, inferred from Si-isotopes" *by* F. Fripiat et al.

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Referee #2 - This is an interesting, well written paper that should be accepting pending relatively minor revision. In this manuscript, in addition to providing two new Southern Ocean data sets for Si isotopes, the authors have calculated net biogenic silica production in the Antarctic Zone of the Atlantic Sector and the Polar Frontal Zone, discussed trends in the d30Si of deep waters from the North Atlantic through to the North Pacific, and brought up points that people will have to consider should they ever actually start measuring d30Si in sediment cores in earnest. Unfortunately, they fly through this all so quickly and with a minimum of explanation that you could blink and either miss or misunderstand most of it. Which is to say, Scientifically, this is a very interesting manuscript but the presentation could use some work (the English is at times awkward

and the explanations and arguments are almost always too terse). As a result, it takes a lot of work for one to follow their reasoning, to notice that they are bringing up a significant point, or to see that they are making a rather significant calculation.

Specific Comments

Referee #2 - 1) Although as a whole, the paper is well written, sometimes the English is awkward or incorrect. It would help to have a native speaker go through the manuscript and get rid of minor mistakes and/or awful sounding clunkers like: - the occasional lack of a comma after an introductory phrase (e.g., the first line of the intro: In the Southern Ocean deep nutrient-rich waters... needs a commas after In the Southern Ocean) - (line 13, p3) (i) species effect difference in the silicification of diatom cells - (line 18, p3) The largest marine zonal silicic acid gradient across the Southern Ocean is thus controlled by surface water Si uptake by diatoms to form opaline cell walls (referred to as biogenic silica, bSiO2), vertical mixing and subsequent intermediate water mass formation - (end of p3) at different timescales (past, present, and future) (past, present, and future are different times not different timescales) - (line 1, p4) The natural isotopic composition of silicon (d30Si) is a promising proxy to overcome both spatial and temporal variabilities in the marine silicon cycle since (also, this phrase doesn't actually make sense... the authors are not trying to overcome variability in the silica cycle, they are trying to overcome the problems that variability on certain temporal and spatial scales has on estimates of silica production, etc) I don't want to correct the whole manuscript, so I'll stop there. But from this, the authors (and editor) should get the gist of what sorts of things need to be fixed.

Authors - We'll try to satisfy the requirement of the reviewer. Virnigia Panizzo (currently at RMCA, Belgium), a native English speaker, will thoroughly review the revised version for English before submission.

Referee #2 - 2) Fig 2. Why are there a couple of blank patches in the interpolations of silicic acid and d30Si in panels a and b?

Authors - The extrapolation will be slightly enhanced in the revised version to remove the blanks.

Referee #2 - 3) I think more needs to be said about the mixing lines in Fig. 4 and how they are used to estimate biogenic silica production. The authors currently speed through this with a minimum of explanation, which means it must be read through multiple times before it begins to make sense. It is not enough that this sort of exercise has been undertaking previously in another manuscript.

Authors - We'll improve the text in the revised manuscript following the comments of the reviewer.

Referee #2 - 4) I also have a few specific questions about this mixing line exercise. - What is the d30Si and silicic acid concentration of PF AASW? I couldn't understand which value on Table 2 this was supposed to correspond to.

Authors - There was some mismatch between estimates in the Table 2 and Figure 6. We decided to remove this table in agreement with the comments of both reviewers.

Referee #2 - The thing that troubles me most about this mixing line exercise is that mixing lines imply that the only process going on is mixing. And yet, we have an end-member (AZ-ML) whose value should be evolving constantly, shifting towards higher d30Si values and lower silicic acid concentrations as spring moves into summer (and diatoms are growing), and then itself being shifted back towards WW values as stratification breaks down and net phytoplankton growth ceases in the autumn and winter. I am not saying that the authors are taking an invalid approach, but I am saying they need to discuss these points here.

Authors - The main assumptions behind these estimations are: (1) the mixed layer represent the final summer mixed layer just at the onset of the wintertime convective mixing when AASW are generated, (2) there is no difference between WW and winter mixed layer (= AASW), and (3) the UCDW Si-supply is mainly occurring when AASW is

generated in winter. (1) This assumption is supported by a Si-uptake in the mixed layer in the lower range of published values for the ACC, 0.02 $\pm$ 0.03 μmol Si l-1 d-1 (mean Si-uptake from 30Si tracer incubations across the BGH transect, n = 27 triplicates), accounting only for 0.6 $\pm$ 0.9% of the available silicic acid concentration (Fripiat, 2010, available online, www.vliz.be/imisdocs/publications/215582.pdf). Moreover it is also in agreement with satellite chl-a data showing that the productive period start roughly in November, peak in December, and collapse in January just before the BONUS-Goodhope sampling (Moore and Abbot, 2000). (2) This was already shown by Altabet and Francois (2001) and Pondaven et al. (2001) for Silicic acid concentration (see text p8 lines 18-22). Moreover, summer silicic acid isotopic distribution is also in agreement with WW as unaltered Si-source for summer mixed layer (Fripiat et al., 2011; Cavagna et al., 2011). (3) This assumption is in agreement with (1) the mixing line of Figure 4 which shown that the AASW are a mixing interface between final summer mixed layer and UCDW, and owing to (2) indicating that AASW = WW.

Referee #2 - 5) p 14l line 5- The comment about the N Pac is not relevant to the discussion in this section and should be removed. It is neither surprising that the N Pac is slightly different to the Southern Ocean in terms of silicic acid and d30Si, nor actually logically supportive of the idea that the Southern Ocean is a complicated place and the patterns observed in the present may not be the ones that existed in the past.

Authors - We agree with the reviewer. This comment will be removed in the revised manuscript.

Interactive comment on Ocean Sci. Discuss., 8, 639, 2011.