Biogeosciences Discuss., 8, C5266–C5269, 2012
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Biogeosciences Discussions

Interactive comment on "Processes controlling the Si-isotopic composition in the Southern Ocean and application for paleoceanography" *by* F. Fripiat et al.

Anonymous Referee #1

Received and published: 12 January 2012

Review of manuscript BG-2011-343 "Processes controlling the Si-isotopic composition in the Southern Ocean and application for paleoceanography" by Fripiat et al.

Overview.

This manuscript presents silicon isotope results made on suspended biogenic matter across a range of depths for 7 stations located in the south Atlantic sector of the Southern Ocean. Fripiat et al. observe that changes in the silicon isotope composition of water and biogenic material samples are associated with strong south-north silicic acid gradient. They then model their results using a box approach, incorporating seasonal changes in productivity, to explain the results they obtained for end of the growth

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season.

Comments. 1) The silicon isotope data presented is of a high-quality and warrants publication. However, the model developed by Fripiat et al. has a number of issues that left me wondering if their model adequately represents the silicon isotope results they obtained. For instance they say that their model "...seems to adequately reproduce the seasonal evolution of silicic acid and biogenic silica concentrations in the PFZ mixed layer (Fig. 5b; Moore and Abbot, 2000; Queguiner and Brzezinski, 2002)". How about showing the reader that the model does indeed replicate seasonal changes in silicic acid concentration by comparing model results to field results? After reading the manuscript, Fripiat et al. imply that they have seasonal silicon isotope data for the region. If they do have silicon isotope measurements for water biogenic samples then it would good to present these numbers as it would help validate the box model.

I suppose my main concern with the box model is that there are only a couple of silicon isotope tie points to constrain the model - day 0 and day 90 - it would be helpful to present data across the growth season so that one can get a better comprehension of the process(s) that are important in the development of silicon isotope composition of the dissolved and solid phases.

2) The trend of increasing isotope fractionation between the water and solid phase in Fig. 3b is similar to the trend observed by Wille et al. 2010 for sponge spicules (note that they expressed their values as the solid minus water). They explored silicon isotope fraction in sponge spicules using an isotope fractionation model that included silicon isotope fractionation during silicic acid uptake, silicon polymerization and silicon efflux from the cell. This model is based on the one presented by Milligan et el. 2004 for diatoms. I would encourage Fripiat et al. to explore this model to explain their data. It could turn out to be the first conclusive explanation for variable silicon isotope fractionation between the solid and aqueous phases in diatoms. Note that this model has also been used by Hendry and Robinson 2012 to describe silicon isotope fractionation in diatoms and sponges. Fripiat et al. also might want to comment on the recent paper

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presented by Sutton et al. at the AGU Fall meeting where they observed varying silicon isotope fractionation factors for Southern Ocean diatoms.

3) Is silicic acid in the STF region sourced from waters moving northward out of the subAntarctic Zone (SAZ) across the subAntarctic Front (SAF)? Beucher et al. 2007, found that the silicon isotope composition of sedimentary opal north of SAF in the southern Indian Ocean did not originate in SAZ "The sub-Antarctic does not appear to be the major source of Si(OH)4 to the subtropics". Could this be the same in figure 2B? If so then the decreasing trend Delta30Si versus latitude is only valid for samples south 45 degrees.

Minor comments are presented on an uploaded annotated version of the manuscript.

References Wille, M., Sutton, J., Ellwood, M.J., Sambridge, M., Maher, W., Eggins, S. and Kelly, M., (2010). Silicon isotopic fractionation in marine sponges: A new model for understanding silicon isotopic variations in sponges. Earth and Planetary Science Letters, 292: 281-289.

Milligan, A.J., Varela, D.E., Brzezinski, M.A. and Morel, F.M.M., (2004). Dynamics of silicon metabolism and silicon isotopic discrimination in a marine diatom as a function of pCO2. Limnology and Oceanography, 49(2): 322-329.

Hendry, K.R. and Robinson, L.F., (2012). The relationship between silicon isotope fractionation in sponges and silicic acid concentration: Modern and core-top studies of biogenic opal. Geochimica et Cosmochimica Acta, 81(0): 1-12

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AGU Fall Meeting 2011. PP51B-1831. Species-dependent silicon isotope fractionation in unialgal cultures of marine diatoms. Jill N. Sutton; Diana E. Varela; Mark A. Brzezinski; Charlotte Beucher

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Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/8/C5266/2012/bgd-8-C5266-2012-supplement.pdf

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Interactive comment on Biogeosciences Discuss., 8, 10155, 2011.