

Biogeosciences Discuss., referee comment RC1
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Comment on bg-2021-42

Frank Dehairs (Referee)

Referee comment on "Early winter barium excess in the Southern Indian Ocean as an annual remineralisation proxy (GEOTRACES GIPr07 cruise)" by Natasha René van Horsten et al., Biogeosciences Discuss., <https://doi.org/10.5194/bg-2021-42-RC1>, 2021

This manuscript brings much wanted information about the Southern Ocean particulate biogenic Ba (Baxs) distribution during winter conditions. Previous studies in the S.O. were all conducted during spring to autumn conditions, showing a seasonal progress of the Baxs signal but lacking information on winter conditions when plankton activity is at a minimum. The mesopelagic Baxs inventory is gauged against integrated PP covering the growth period preceding the sampling, and these data are combined with literature data revealing an interesting correlation.

I wonder why authors, when comparing their data with literature, have considered data from specific expeditions and not from all available data for the S.O. . In particular the Baxs data presented in Dehairs et al. (GBC 1990; INDIGO 3 expedition, 1987) for the same general area as studied by the present authors were not considered. During the INDIGO 3 several stations were occupied along approx. 30°E between 65°S and 57°S. S to N Baxs inventories are similar to values reported in the present ms., confirming indeed that microbial activity in the mesopelagic area is still ongoing during winter period. Further data that have not been included in the Baxs inventory – PP comparison are those from Dehairs et al. (1997) obtained during Polarstern ANT X/6 expedition along 6°W in early season. If possible these two data sets should be included in the compilation.

Authors do not provide information how integrated PP was obtained for the compilation of literature data. Figure 1 should differentiate the different Baxs data sets.

Authors do not provide any information on sea ice extent relative to position of the southernmost station.

While it makes sense to compare Baxs inventories with PP intensity in the months preceding the sampling, the coinciding Chlorophyll data shown in Fig. S1 still are relatively elevated reaching about 0.5 µg/L at the the PF and in the SAZ, this taking into account that S.O. Chl values of 1 µg/L can be considered bloom values. Please comment.

Not sure Figure 4 adds to the understanding. This figure could be ommitted.

Specific comments

Line 67, page 3: Dehairs et al. 1980 more appropriate as ref. here than dehairs et al. 1997.

Lines 58-59: Surface export is set by the deficit (not excess) of ^{234}Th activity vs. ^{238}U activity. Specify that $^{234}\text{Th}/^{238}\text{U}$ ratios >1 can occur below the upper 100m, or so, reflecting remineralisation.

Lines 26-28 page 10 and lines 75-76 page 16: Sample numbers $n=39$ (SPF) and NPF ($n=31$) pertain to what? Table S1 shows only data from the present study and not the compilation data set.

Lines 46-47 page 11: Opposite gradients of Baxs and diss. O_2 . Please provide more detail.

Lines 65-79 page 16: These sentences are confusing. If there is no significant difference in relative amount of POC remineralized relative to PP (all stations except STZ), then there is no difference in response of Ba relative to PP at the different stations ..? Only the STZ site behaves differently.

Also, high productivity, low export can be associated with large particles in the surface layer (see Lam & Bishop, 2007). High surface water productivity associated with low export has also been described in Jacquet, Lam, Trull, Dehairs, DSR II, 2011. The possibility that high phyto biomass attracts more grazing and is more depending on recycled production (NH_4 based) and thus results in smaller export (more surface water recycling) and possibly lower mesopelagic Ba, is reported also in Dehairs et al., 1992.

Line 76 page 16: ".. are comparable to surface export efficiency obs. In this region ..." which region?

Line 88 page 17: this sentence is unclear. Similar latitudinal trend (of what?); higher values NPF (values of what?)

Line 90 page 17: saturated vs undersaturated: specify saturation for dissolved Ba.

Table S2: Add lat. position for each site

Figure S1: top panel indicate AZ, PFZ, SAZ. Why is the STZ station not reproduced here?

Table S3: Add the Lat-Long range for the basin regions