

Biogeosciences Discuss., referee comment RC2  
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## Comment on bg-2021-42

Stéphanie Jacquet (Referee)

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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-RC2>, 2021

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This manuscript presents a new data set of excess particulate barium ( $Ba_{xs}$ ) concentrations in the Southern Ocean during winter conditions. Correlation with integrated PP and data from literature is interesting. My major comment concerns the conclusion that the Ba proxy would have a longer timescale than previously thought. I don't think that there is a cumulative effect on the  $Ba_{xs}$  signal for the reasons explained below. I suggest that authors revise their discussion (and reformulate abstract & conclusion).

- Chl a data reported in Figure S1 indicate that stations (northern 50°S) experienced production (even of low intensity). This should be compared with Chl a and  $Ba_{xs}$  data from other campaigns (e.g. Cardinal et al., 2005; Blain et al., 2007). The winter period appears to be productive in this sector. This would explain why  $Ba_{xs}$  present similar contents as reported during other seasons.
- Data should be compared to results from the Indigo3, EPO2 and ANTX/6 cruises.
- Line 15-19: Please revise the abstract (and part of the conclusion). I don't think it's a question of timescale and cumulative effect. If POC is produced in surface and that remineralization is sustained at mesopelagic depths,  $Ba_{xs}$  will be produced, independently from the season. There is no clues that POC material could accumulate at mesopelagic depths and conducts to latter (weeks to months after the growth season) remineralization and  $Ba_{xs}$
- Figure 4: not necessary -it does not add to the understanding. It should be (in-depth) compared to contrasts reported in Jacquet et al. (2011; SAZ-SENSE cruise): diatoms vs. flagellate, PP, EP, Fe depletion or enrichment, type of aggregates. The effect of the contrasts on  $Ba_{xs}$  and remineralization during SAZ-SENSE was opposite to these reported during KEOPS (Jacquet et al., 2008) and EIFEX (Jacquet et al., 2008) cruises. This should be compared to the present data set.
- Line 71-82 p11-12 (and Line 90 p17: not clear, please reformulate). Are dissolved Ba and SI available? The SO is globally undersaturated ( $SI < 0.9$ ) or at the equilibrium ( $0.9 < SI < 1.1$ ) with respect to barite. Saturation is unusual. Please correct it line 73.
- Also, in productive situations (and deep POC transfer), it is common that  $Ba_{xs}$  at 1000 m depths remains larger than the "180 pM" SO reference.
- Finally, as recently reported in Jacquet et al. (<https://doi.org/10.5194/bg-2020-271>; Peacetime cruise) remineralization at mesopelagic depths could be restricted to the upper mesopelagic layer or extend up to 1000 m depending the system functioning

during a same season. This leads to major differences in the  $Ba_{xs}$  background reached at 1000 m depths.

Please revise your discussion and conclusion according to these comments.