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Biogeosciences Discussions

Interactive comment on "Late summer particulate organic carbon export and twilight zone remineralisation in the Atlantic sector of the Southern Ocean" *by* F. Planchon et al.

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This paper describes measurements of 234Th and of particulate Ba on a transect across the Antarctic Polar Front largely along the zero meridian. The study is part of the Bonus Good Hope expedition, which was organized in the framework of the International Polar Year and was linked to the GEOTRACES program. The data appear to be of excellent quality. This can very well be seen in the 234Th data that must be precise and accurate to show the clear evidence of disequilibrium, both negative in surface waters and positive at depth. In my view the central message of the paper is the agreement between mineralization estimates (but not their exact depth distributions)

based on two completely independent datasets. I think this an amazing result that would deserve more emphasis. In the abstract this major result is somewhat buried in a quite detailed description of distributions with latitude and grain size. Apart from this change in emphasis I think that the paper can be accepted with minor change.

There is one issue that I would like the authors to discuss in some more detail. In Fig. 4 the errors indicated for the cumulative flux are very small. Errors in the 234Th/238U ratio (Appendix) show that the error in the depletion at every level is appreciable, in spite of the excellent quality of the data. The error in the cumulative disequilibrium inevitably increases with depth, which makes the application of 234Th tracer at large depths prohibitively inaccurate (see eg Harada in Buesseler et al., 2007 fig. 5.1). I would like the authors to comment on this and indicate how the errors were propagated. And ultimately what errors are associated with their estimates of the residual export at 600m.

Detailed comments:

P 3428 line 18 station locations rather than cruise track

P 3430 line 26 When deep waters were used for calibration, the average value was set at 1, and you only have to give the standard deviation.

P 3432 eq. 3. check sign in exponent of denominator Line 12 and beyond. The formulation 53»1 μm is not clear. Use a clearer expression to describe the fraction between 1 and 53 μm Line 22 custom-built? Line 22 plexiglass. Does this not cause possible contamination for POC analyses?

P 3435 line 8 where

P 3436 line 2 appear Line 8 Be consistent in the use of ML or MLD. Refer to Table 1 for the source of MLD. Line 9-12. This description of the latitudinal trend of depletion cannot easily be followed.

P 3438 line 12. Partly: what else? Line 13 check symbol

P 3441 line 5 The parallel Polarstern study at the Zero Meridian did not show a clear latitudinal gradient in POC/234Th ratio, but the Drake Passage section did. Line 19 and 3443 line 11: The Polarstern study used 50μm screens, just like BGH.

P 3443 line 17 Our and their ratios for large particles Line 23 and beyond. The use of the term “attenuation” with negative values and yet qualifications as: low, high highest is very confusing

P 3444 line 24 to top of 3445. This is a rather repetitive formulation of the relationship between Ba and MLD.

P 3445 line 5 can be found down to Lines 18-21 This paragraph describing figure 10 (not 9) can better be moved altogether to the discussion to prevent repetitions.

P 3447 line 5: the preceding cruise.

P 3447 Section 4.1.1. is really rather long

P 3449 line 15 and beyond: EP100: use subscript 100 EPML define at first occurrence

P 3450 Lines 2-3 define the effect of enhanced nutrient recycling (in the North?) on POC export more explicitly L 21-24. I cannot follow the logic of this sentence

P 3451 line 3-4 either “may indicate” or “appears”, not both. Line 26 yields a correlation coefficient

P 3452 “a large fraction is mineralized” or “export production is strongly attenuated” Line 28: with by ??

P 3453 line 1 Why would zooplankton migration affect total 234Th distribution? Line 11 has been reported before in the Southern Ocean

Tables

Table 4: Title: consumption rate; respiration rate

Column 5: these values have a very small range, much smaller than the MLD

Note a: when the flux is integrated over depth why tell that it was depth-weighted?

Figures

Fig. 7: I think it would be clear to add that the first POC/Th ratio estimate was based on the average from the MLD to 300m

Fig. 9. Indicate that the export estimates were based on the 234Th data

References

Buesseler, K. O. et al., 2007. Estimating upper ocean particle fluxes with sediment traps: a progress report. Journal of Marine Research 65, 345-416.

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