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Biogeosciences Discussions

Interactive comment on "Bathypelagic particle flux signatures from a suboxic eddy in the oligotrophic tropical North Atlantic: production, sedimentation and preservation" *by* G. Fischer et al.

G. Fischer et al.

gerhard.fischer@uni-bremen.de

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We first like to thank D. Archer (Reviewer #2, RC) for the constructive comments, interesting suggestions and for the time and effort spent to review the manuscript.

RC: The sediment trap data here is interpreted vertically, but I wonder if that's appropriate. The authors argue that given a sinking velocity of 100 meters per day and some typical horizontal flow velocities, particles wouldn't travel very far in the horizontal. The problems with a vertical explanation for the fluxes found here are (1) the deep trap received more material than the shallower one. (2) The fluxes of dust also spiked during the eddy's passage, although there is no strong evidence for a particular focusing of

dust deposition fluxes at the sea surface associated with the eddy.

The oxygen depletion grew in place, and there are higher concentrations of chlorophyll in surface waters than outside of the eddy, so some component of the excess organic carbon fluxes measured must have been grown locally. But the dust fluxes imply that there must be some horizontal focusing mechanism, or a buildup in time of depositional fluxes, in addition to any biological signals in the sediment trap. In fact, the unusually tight correlation between the dust and the organic carbon makes me think that the focusing mechanism must dominate over the local biological fluxes.

Could the upwelling jet in the eddy be acting as a particle trap, actually inhibiting sinking by carrying small particles upward? Particles would build up in the water column like snowflakes in a blizzard. When it passes by the sediment trap mooring, material settles into the traps and is recorded. It would explain the dust, the synchronicity of the spike between the two depths, and the higher fluxes in the deeper trap.

AC: D. Archer exactly raised the major problem with the upper and deeper flux record of the eddy. We discussed his problem in our author group of oceanographers, biogeochemists, paleontologists and geologists. With respect to the increase of fluxes collected with the deeper trap, we considered potential scenarios for horizontal transport processes in our old version (chapter 5.4). It is evident that the upper and lower trap fluxes are temporally coupled in some way (e.g. bulk flux patterns, organisms, C/N-ratios). There must be a vertical transport component as well.

The reviewer is right in stating that we cannot explain the data set in a satisfactory way by only interpreting it in a strictly vertical sense. Indeed, we considered several scenarios (e.g. 'particle focussing') within the eddy to explain the critical points mentioned by D. Archer. However, at the time of writing, we found these scenarios too speculative to be integrated and discussed in a reasonable way. One possible explanation of the 3-fold increase in fluxes with depths might indeed be related with a certain degree of particle focussing/concentration of the particles within the eddy, which may operate as

a twisted funnel with some downward movement of particles at the eddy's boundaries. We cannot prove this with the present data set and it remains speculative. There is still a clear lack of knowledge on how different types of eddies behave in the upper and deeper water column (oceanography), in particular with respect to particle transport processes. Fine particles (dust) may indeed be carried upwards at the edge of the eddy in the water column, and might interact with organic-rich particles to build marine snow aggregates. This might result in a close relationship between the organic carbon and dust particles.

We have rephrased the former chapter 5.4. ('Differences of fluxes in the water column') accordingly. This chapter is now named 'Increase of mass fluxes with depth and flux focussing' and includes the suggestions and thoughts of D. Archer as discussed above.

Interactive comment on Biogeosciences Discuss., 12, 18253, 2015.