

Interactive comment on “Quantification of the lithogenic carbon pump following a dust deposition event” by M. Bressac et al.

Anonymous Referee #1

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The manuscript by Bressac et al. describes results from a mesocosms experiment, investigating the effect of dust addition on the sedimentation rate of POC. Previous studies suggest that minerals like lithogenic particles act as ballast for the downward transport of organic matter in the ocean. However, as the authors also emphasize an accurate understanding and quantification of the POC-dust association in the upper ocean is currently lacking. This study indicates that POC fluxes are strongly increased after dust addition yielding a linear relationship between dust flux and POC. The authors attempt to explain the observed enhancement of POC sedimentation by two main processes: a) the direct ballasting of POC that increase settling speed of particles, and b) a fertilization effect that results in higher biomass production and thus in higher export fluxes of dust amended mesocosms.

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Specific comments: An enhancement of POC fluxes after dust addition meets well with our expectations, based on previous studies that showed strong co-occurrence of POC and minerals in deep water sediment traps, or higher settling velocities of mineral-organic aggregates. In this manuscript, however, there are several issues that need to be addressed and better explained, to convince that the presented results are novel and give deeper insight. Even if the manuscript is part of a Biogeoscience special issue with more information likely given in accompanying papers, enough information should be given also in this paper to support interpretation of data. 1) The method of dust addition and the dust size frequency distribution could have large impact on the interaction of dust with POC and need to be described in more detail. The authors wrote that addition of 10g dust m⁻² (i.e. 41.5g in total) mimics realistic wet deposition; but over what time? How fast was the dust added and spread? Is the amount still realistic when deposited all at once? 2) Since the authors speculate about a fertilization effect of dust, it is indispensable to show nutrient data, or better explain how the dust addition increased biomass production. 3) Likewise, it is essential to include POC concentration from the water column. As the authors also note, PP cannot accurately predict POC fluxes. Thus, knowing POC concentration of the water column would give a much better insight into the partitioning of PP into particles and sedimentation processes. 4) PP data were integrated over the water column (0-12.5m) assuming a homogenous profile. Given the determined changes in light attenuation after dust seeding, the assumption of a homogenous profile seems to be wrong for light. What was the light intensity during the experiment? Could photoinhibition explain lower PP in the non-seeded mesocosms? 5) The authors should add an error estimate for POC fluxes that are given as average. 6) Was PP comparable between mesocosms before dust addition? The data shown in Fig. 5 suggest a large variability in PP of replicate dust mesocosms. Please indicate replicate mesocosms. 7) POC flux in dust amended mesocosms was quite comparable after both seedings, while POC control flux was different. Moreover, OM carrying capacity of dust was lower than determined for minerals during previous studies. This could indicate that DOM sorption onto dust, rather than

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dust – particle interaction was responsible for observed POC fluxes. As the trap material was collected for analyses during this study, there must be more information about the quality of sinking particles. Were there visible aggregates or fecal pellets? Which were the dominant phytoplankton species/ size in the traps? What was the C:N ratio of sinking particles? 8) Sorption of DOM onto minerals is a well-known phenomenon and should be discussed in more detail here, referring to the work of Arnarson and Keil. Measurements of DOC, if available, should be included in this discussion. Perhaps, if the same type of dust is still available, side experiments with filtered seawater can still be conducted to determine the amount of carbon adsorbed onto the dust surface.

Technical comments: The manuscript should be carefully revised and spell-checked by a native speaker

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