

Interactive comment on “Chemical fate and settling of mineral dust in surface seawater after atmospheric deposition observed from dust seeding experiments in large mesocosms” by K. Desboeufs et al.

K. Desboeufs et al.

desboeufs@lisa.u-pec.fr

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We thank the referee for the careful reading. The reviewer raises important issues. Below are our responses with explanations of changes (as the two referees have some of the same comments, we repeat our responses in the two responses). We have also addressed in detail all the specific comments.

1. The present manuscript is hard to read. The use of scientific English is not strong, which makes it difficult to assess the science. The overall message(s) of the manuscript

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disappear(s) in a forest of words and convoluted paragraphs. A very simple story needs to be conveyed. It also needs to be made clear that the current manuscript adds knowledge that is not already presented by others in the mesocosm team. It seems that the manuscript adds little new knowledge.

Authors' Response: Taking these comments into consideration, we now have re-organized the manuscript to clarify our original findings in comparison of the other papers of the special issue. We hope now that the scientific merits of the study are clearly demonstrated. The introduction has been modified to present the context focused on the objectives of the paper, i.e. using of sediment traps or records to estimate the dust deposition in the Mediterranean Sea. The objectives have been re-written in order to clearly point the topic of this study and emphasize the two questions attached to this manuscript, i.e. (1) what is the relevance of various proxies of terrigenous or productivity fluxes in case of high dust deposition? and (2) what is the link between dust and POC fluxes as a function of type of dust deposition? The last paragraph of the introduction has been changed to place the objectives of this manuscript in relation with the paper of Bressac et al. (2014) in which the dust and POC fluxes are also discussed during the DUNE experiment. The Results and the Discussion sections are totally re-organised: The calculations of mass budget in the sediments traps and in the mesocosms and the estimation of various fluxes are made in the Results section. The Discussion section is divided in two parts: one first part on the relevance of proxies and one second part on the link between dust and POC fluxes. This separation between calculations and discussion enabled to highlight the findings, previously lost in the analyses of results. The discussion on the use of interelemental ratios as proxies has also been reinforced by an analysis of the ratio Co/Al. Moreover, the discussion on N export (previously in P4920 and P4921) has been deleted to clarify the paper. The paper has been carefully read and the sentences have been rephrased, simplified and clarified as far as possible.

2. Specific comments.

BGD

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Abstract: line 14. In the water column... Unclear: I think this means in a dissolved form. R: We have changed the sentence by: "the particulate phase both in the water column and in the sediment traps was dominated by dust particles" Abstract Line 27: is this a weight ratio? "Mass ratio" it has been specified

P 4911: I assume this is a process paper, not a database? R: We agreed, so we have deleted the section in relation with the database

P 4911: Line 6: what is a main nutrient. Overall sentence is vague. Line 6-7. This is awkwardly phrased. Is it an exclusive processes? Line 9: is the role of dust critical as it may have a dual function. I do not think this is correctly phrased. Line 11-13: this sentence is so convoluted that it has lost its meaning. Line 14-19. I assume that this not the topic for this paper. Why put this issue forward here? What is surface dryness?

P 4912: line 6: why is this. Al can be used as a proxy for dust inputs independent of opal and CaCO₃ production and settling. The lithogenic flux is very low in most oceanic environments, but in the Mediterranean and off NW Africa it is a very significant part of the particle transport in the water column. Line 9: the question is whether the dust provides the ballast to the organic matter through its higher density, or organic matter facilitates dust sinking though facilitating agglomeration. R: In response of these specific comments, the introduction has been changed to focus on the role of dust deposition in Mediterranean and the interest to use sediment measurements to estimate dust fluxes. So, the two paragraphs have been also re-phrased.

Line 15: 'trace metal clean' I assume : yes, it has been added Line 19: stream? This should be currents I presume: yes, it has been added Line 23: what is meant by: source to sink transfer of added dust? What is the particle sorting? It has been rephrased

Line 26: the elements chosen are confusing. Surely Fe is part of phytoplankton, and so is Mn, Mo, P etc. : R: We have changed: "The suite of elements was chosen to include nutrients (N, P, Si, Fe and trace metals: Mn, Cu, Co, Mo), elements used as

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proxies of marine productivity (POC, Ca, Ba), elements used as proxies of dust input (Al, Ca, Ti, Nd)." P4913: Line 8: what is meant by 'the accuracy of the strategy'? It has been deleted

Line 19: a seeding does not happen (when researchers are adding dust), but are undertaken: We have changed

Line 23: what is difference between Dune P, Q and R? R: The difference between the seedings is now presented in the introduction: " The set of DUNE experiments simulated so either wet (DUNE-P), dry (DUNE-Q) or a succession of two wet deposition fluxes (DUNE-R) of 10 gm⁻² of Saharan dust."

P 4914: Line 1: The spray consisted of what? Line 8: what is diluted dust? Diluted with what? The details of seeding methodology are described in Guieu et al. (2010) as mentioned in the manuscript. Dust was diluted in local seawater (41.5 g in 2 L) then the mixture was spread at the surface of mesocosms via a sprayer (see photo in Guieu et al., 2010). Line 16: . 'We used for seeding the fine fraction of soil as analog to Saharan aerosol particles (Desboeufs et al., 1999) in order to obtain enough quantity of the same material.' This is very awkwardly phrased. Please rephrase: Taking into account the comments of the second referee, it has been deleted.

P 4915: Line 23: a reference is needed to the protocol: No reference is available to describe the protocol : It is the reason why the protocol is then described. Line 25: was the MQ water buffered to pH ca. 8 in order to minimise leaching of trace elements (MQ water has a pH of ca. 5.5 when not buffered): No, we suppose that the additional leaching, related to the difference of pH, is negligible since trace metals have a very low solubility (even at pH 5.5) and the time of contact between MQ and sediments material is very short (just rinses).

P 4916: Line 5: check for what? We have specified: "to check the efficiency of the acid digestion protocol" Line 9: what is SLRS? We have added: "River water standard materials from NRC" Line 13-14: sentence contains repeats: We have changed by: "In

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order to follow both the settling of the added mineral particles through the mesocosms and the change of their chemical composition,..." Line 19: Where the filters not acid washed prior to use? What was the filter blank level. No, as noted, the filters were only washed by filtrating one liter of seawater. "The blank level was below the detection limits except for Al, Fe, P and Ti with typical blank level around 1 $\mu\text{g/L}$ for Al and Fe and 500 ng.L^{-1} for P and Ti." has been added.

P 4917: Line 2: What was the limit of detection? We added: "(around 100 ng.L^{-1})"

Table 1: explain all abbreviations used in table: R: We have added in the legende "Dust07 and Dust09 correspond to the soil sampling made in Tunisia in March 2007 and March 2009 respectively; the evapocondensed soil is noted EC-Dust, and the fresh soil is noted NEC-Dust," Table 2: please use SI units (ppm is outdated): We do not agree, we worked with mass ratio all along the paper, so the use of ppm is adapted for the discussion presented in this paper.

Page 4919: line 11: 'showing that the chemical composition of sinking particles collected in sediment traps did not evolve after the first 24 h during an experiment.' What does this mean. How does a composition evolve? R: This sentence has been deleted and the explanation on the chemical change of sediment materials as a function of time has been clarified. Line 23: avoid the word evolution in this manuscript. Done.

Page 4920: Line 23: is it correct that there is more nitrate than N in the mesocosms (on a mole basis)? Line 29: this looks like is a circular argument. I understand from section 2.2. that you added the N to the dust during the processing, and obviously it will be become a source to the surface ocean then. Page 4921: Line 12-16. I really cannot follow the reasoning here. Line 21. A potential is not really sensitive?! R: In order to clarify the objectives of the paper, the discussion on N has been deleted in the revised version of the manuscript.

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