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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Atmospheric acidification of mineral aerosols: a source of bioavailable phosphorus for the oceans" *by* A. Nenes et al.

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We thank the reviewer for the enthusiastic response and suggestions for improvement.

Specific Comments:

I found it to be a bit odd that the methods were not included in the text, unless this is specific to the journal I would reorder the manuscript.

The methods are now included in the main text.

In the abstract I suggest making the second sentence clearer that you're taking about oceans and that freshwaters are excluded from the statement "Deposition of atmo-

sphereic aerosols provides the major external source of phosphorus to surface waters." Perhaps change to ": : : marine surface waters." Similar issue with the last section of conclusions and implications section.

Good point! Done.

In numerous spots you mention iron hydroxide minerals. I was wondering if you should also add/discuss iron oxyhydroxide minerals as well?

We have added two sentences in the conclusion and implications section noting the similarities between these processes as they effect P and what is known about acid processes changing the bioavailability of Fe in mineral dust. However at this stage the potential interactions between these two processes is completely unknown and will no doubt, as a result of this paper, be the subject of future research work.

Lots of good discussion on the thermodynamics of the reactions, but little on the kinetics (e.g. page 6168 lines 24-26 and 6175 lines 22-23). I don't think this detracts much from the paper, but it could be an area of further investigation.

The reviewer is indeed correct that nothing is said (or known about) the kinetics of these reactions. This is an active area of research for us.

On page 6169 lines 29-30, Its not clear to me why the P won't co-precipitate with the iron in the oxic surface water. Is it a pH issue or something else?

Our understanding is that dissolved Fe and P are supplied simultaneously with aerosols to surface waters. The dissolved Fe then reacts with the alkalinity in seawater and rapidly precipitates as reactive Fe nanoparticles. However this process takes a finite time even if that time is measured in seconds. During that time, the phosphate is rapidly diluted away from the aerosol source and thus does not reprecipitate onto the original particle. Since the number of aerosol particles even in a major dust event is small compared to the volume of surface water,there is no substantial subsequent readsorption and most of labile P is available for uptake by the abundant phytoplankton

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(usually in numbers of $\sim 10^5$ cells/litre).

The abbreviation of phosphorus as P is not consistent throughout, sometimes phosphorus is spelled out and other times abbreviated. I'd suggest spelling it out the first time then abbreviating it the rest. Similarly, LIP is sometimes referred to as leachable phosphorus and other times leachable inorganic phosphorus and sometimes abbreviated LIP. I'd suggest clarifying if it is leachable phosphorus OR leachable inorganic phosphorus and then defining it once and abbreviating it thorough the rest of the manuscript.

Good point! Done.

I didn't notice any discussion about blanks, spikes, or matix spikes. I always think these add to the strengths of the data in a paper if they are included

We have added data on the accuracy of our IC measurements and the precision of our P speciation measurements to compliment the information of measuring total P by two independent methods. We have also noted how we dealt with known matrix effects on our analytical procedures and on our use of blanks.

Fig 1 and Fig 2 I don't like that the symbols for course and fine are the opposite in each. I'd prefer if the course and fine had the same symbol in both the figures as it makes comparisons easier.

We've ensured that the symbols are consistent on the Figures. We had to use a "x" symbol for the fine mode data in Fig 2b, because the diamond covered the coarse mode data (and made them effectively invisible).

Technical Corrections:

Page 6165 line 10. add 's' to the end of increase

Change is made

Page 6165 line 11. chance 'is' to 'were'

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Change is made.

Page 6166 lines 3-5. either combine as one sentence or cite the "7 to 100

Sentences changed to "Mahowald et al. (2008) estimate that globally about 17% of total atmospheric P deposited at the sea surface is water soluble. The soluble fraction, however, is highly variable, with values ranging between 7 and 100% (Mahowald et al. 2008)"

Page 6166 line 16. insert 'aerosols' after 'phosphate' and before 'is'

Sentence changed to "Production of soluble P in aerosols is analogous to that invoked to explain the presence of soluble iron and trace metals in atmospheric dust"

Page 6167 line 11. my copy made it seem like there was no space between 'aerosol' and '(Seinfeld : : :'

We made sure there was a space.

Page 6169 line 12. you use the abbreviation LIP but it has not been defined

LIP is now defined early in the manuscript and used consistently throughout.

Page 6167 line 15. 'phosphorus' already defined as 'P' so just use abbreviation

Change is made.

Page 6172 line 17. you say LIP is leachable phosphorus, but you already have said that LIP is leachable inorganic phosphorus . . . which one is it?

It is LIP. We have not corrected the manuscript.

Page 6174 line 2. Delete 'use' and after 'pre-calculated' add 'using'

Change is made.

Page 6174 line 14. LIP is already defined

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Definition is removed.

Page 6176 lines 13 and 14. don't need to spell out phosphorus as you've already established it can be abbreviated as "p"; same issue with LIP

Good point. The redundancies have been removed.

Page 6177 line 12. a 's' to the end of 'method'

Change is made.

Page 6177 line 14. add the material that the 15 ml tubes were made of

Done.

Page 6178 line 9. should cite the molybdate method used

Done.

Table 1 . You say leachable LIP, which is like saying leachable leachable inorganic phosphorus. Either delete leachable and leave LIP or write out leachable inorganic phosphorus

We apologize for this oversight. Change is made.

Fig. 2 (a). express ratio on y-axis as P:Ca rather than P/Ca. Should x axis la bel be umol m-3 rather than what you have listed ummol-3?

Change is made on y- and x- axes.

Fig. 2 (b). y-axis says phosphate, but text under it says total dissolved P – is it P (phosphorus) or phosphate? Decide and switch one of the two so they match. Also in the text under Fig. 2 delete the comma after Ca5(PO4)3F as throughout the text you haven't used a comma after the second term in a list

Changes are made as suggested. Thank you for pointing them out.

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Interactive comment on Atmos. Chem. Phys. Discuss., 11, 6163, 2011.

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Interactive Comment