Atmos. Chem. Phys. Discuss., 8, S10944–S10948, 2009
www.atmos-chem-phys-discuss.net/8/S10944/2009/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Observation of nitrate coatings on atmospheric mineral dust particles" *by* W. J. Li and L. Y. Shao

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Received and published: 5 February 2009

We thank Dr. Dulac for his/her constructive comments. They have been useful in improving the manuscript. We have modified our manuscript in response to these comments.

Q: Comments from referee; A: Answers from author; Italic sentence: New sentence or revised sentence.

(**Q1**) I think that your interesting manuscript is missing statistics on the number of particles upon which your different results (sections 3.1 and 3.2, figs 3 and 6) are based.

(**A1**) Thanks for your comments. We added number of particles in sections 3.1 and 3.2, and Fig.6 We revised one sentence on Page 19255 line 3.
Size distributions of 332 coated mineral particles range from 0.4 to 16 μm with a median diameter of 3.1 μm (Fig. 3).
We added one sentence on Page 19255 line 13.
A total of 330 coated mineral particles in ten haze samples and two coated mineral particles in one dust sample were investigated using TEM/EDX.
We revised one sentence in the caption of Fig. 6.
Fig. 6. Ternary diagrams showing EDX data of elemental compositions of Ca-rich coatings of 236 mineral particles. Reference areas represent the elemental compositions of laboratory generated $CaCO_3$ (red ellipse) and $Ca(NO_3)_2$ (blue ellipse) particles. All the particles were analyzed in the same TEM system with very close conditions.

(**Q2**) Since you are making overall averages based on samples collected during very short periods over different episodes of high turbidity, and that you analyze only a subset of every selected sample (by the way you could indicate how much of the sample the 4 windows analyzed do represent), I find necessary to argue on the robustness of your results. For instance you should check whether analyzing several sets of 4 windows on the same sample provide consistent results, whether analyzing 2 different samples of a given episode provide consistent results, and whether results from one haze episode to another are consistent. A too great variability would put concern on the significance of your averaged results, probably given with a too high precision (e.g. at the 1% level for the different types of particles in section 3.2).
(**A2**) We collected the samples using a single-stage cascade impactor with a 0.5-mm diameter jet nozzle. It is necessary to minimizing the sampling time in order to avoid overloading on the filter. It would make analysis possible using TEM. The short time used in this kind of samplers commonly has been used in other studies for TEM study (e.g., (Zhang et al., 2000;Ikegami et al., 2001;Naoe and Okada, 2001;Okada and Kai,

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2004)).
We have analyzed two or more different samples in a given haze episode. Mineral dust particles all have a consistent result, although other particles types (metal particles and secondary particles from our observations) have some differences. We analyzed two samples in the different haze episodes. The results are very similar during the sampling periods from May to June. Prior to analysis, particles collected in all samples examined have similar distributions on TEM grid. The distribution usually equally scatter from the center to periphery. Number of mineral particles decrease from the sampling center to periphery. Therefore, we always choose three to four areas from the center to periphery along with one direction. Based on the primary observations, I conducted analysis of compositions of the coated mineral particles in the haze samples. Therefore, the analyzed areas can reflect the entire sample. Additionally, the observations indicate that the average result can represent the coated mineral particles collected in the similar haze episodes during June.
We add one sentence to indicate number of the analyzed particles.
There were between 10 and 40 mineral particles measured in each haze sample.

(**Q3**) Although it is not quite clear whether the quantitative results on coated particles and coatings shown are averaged by mixing the 10 brown haze episodes plus the single desert dust episode, it seems to be the case. Is this justified?
(**A3**) We added one sentence on P19255 line13, please see (A1).
It is justified in this paper because our purpose focused on the properties of different coatings and possible mechanisms of their formations on mineral particles.

(**Q4**) The dust case is hardly discussed in the paper. It would be interesting to comment whether the coated particles have a specific composition compared to the non-coated ones? The information given in the conclusion on the large difference in the fraction of coated particles between brown haze and desert dust cases (about

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90% and 5%, respectively) is important and might also be given in the abstract.
(**A4**) Here we focused on the coated mineral dust particles in haze and dust episodes. The dust episode was only acted as one background sample. We observed that the coated particles include silicates and carbonate compounds. Some of non-coated particles also include carbonate compounds. The possible explanation is that the low humidity and anthropogenic gases in dust storm can limit the chemical modifications on mineral dust particles. According to referee#2's comments, we add one table to show the components of mineral cores. It may explain the question.
We added one sentence on Page 19257: *abundant mineral dust particles containing calcite or dolomite without coatings were detected in the dust sample.*
TEM observation indicates that approximately 90% of the collected mineral particles are covered by visible coatings in haze samples whereas only 5% are coated in the dust sample. 92% of the analyzed mineral particles are covered with Ca-, Mg-, and Na-rich coatings, and 8% are associated with K- and S-rich coatings.

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Interactive comment on Atmos. Chem. Phys. Discuss., 8, 19249, 2008.

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