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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

**W. J. Li and L. Y. Shao**

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We thank the referee 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**) As indicated by both other reviewers, clear presentation of particle statistics in each of the samples is needed. I also second the comments that authors need to present the general differences and/or similarities in major types of original (uncoated)



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mineral dust particles arriving from northwest (dust episode) and southeast (haze episode).
(**A1**) Thank you for your suggestion. We made one table to show mineral components of cores in coated mineral particle, according to the referee#1's comments. The table shows that most individual mineral particles collected from haze episodes are mixtures of silicates and calcite/dolomite/halite. A similar observation was also made on dust particles collected from dust episodes. We add two sentences in section 4.1.
*Consistent with this conclusion, abundant mineral dust particles containing calcite or dolomite without coatings were detected in the dust sample.*
*Our results also show that $Ca(NO_3)_2$ and $Mg(NO_3)_2$ coatings preferentially formed on mineral particles which contain calcite and dolomite components (Table 1).*

(**Q2**) It needs to be clearly indicated that analysis of C, N, O is semi-quantitative at best. The Ca-N-O ratios measured in this work and presented in the ternary diagram of Fig 6 are not necessarily comparable with the reference areas described by Laskin et al, 2005b (JGR, 110, D10208). Those areas were determined experimentally using laboratory prepared particles of $CaCO_3$ and $Ca(NO_3)_2$ and applicable for the specific settings of the SEM instrument used in that study. For the purpose of the presented manuscript, the reference areas need to be identified using the same instrument and beam settings applied for the reported particle analysis.
(**A2**) We indicate that analysis of C, N, O is semi-quantitative.
We used TEM/EDX to obtain elemental compositions of different parts in individual particles through the control of electron beam. The EDX results are semiquantitative, especially for light elements, such as C, N, and O.
We noticed the problem indicated by referee#1 and referee#2 about your second comment. We made standard $CaCO_3$ and $Ca(NO_2)_2$ samples in laboratory and add the data from the same TEM in 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 com-*



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*positions 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.*

(**Q3**) Figure 1 and its caption. On the map I see 7 blue; trajectories which have no legends on them. On the other hand, I see 9 blue; records on the RH panel of the figure. How are they related? Also, it might be useful to present height records of the corresponding air plumes.
(**A3**) The humidity is included because it affects heterogeneous reaction between mineral dust particles and acidic gases in troposphere. From Fig. 1, humidities in haze days are higher than these in dust days during their transports. Therefore, it is evidence to discuss the related reactions that can occur on mineral dust particles. We add the legend and height records in Fig. 1.
*Fig. 1. Ten 24-h backward trajectories of air masses arriving at Beijing at 500 m and their relative humidities between 24 May and 21 June 2007. Humidities from 20 to 50% along with heights from 500 to 2200 m were shown in one dust air mass (red lines) from northwest of Beijing; Humidities from 20 to 92% along with heights from 20 to 1000 m were shown in nine haze air masses (blue lines) from southeast of Beijing.*

(**Q4**) Text of the manuscript requires extensive editing to improve the language. I strongly recommend to the authors to seek help of a professional editor.
(**A4**) We revised the English.

(**Q5**) EDS stands for Energy Dispersive Spectrometer/Spectrometry which therefore sounds awkward when used as EDS analysis;. More correct form would be EDX analysis; which is Energy Dispersive X-ray analysis; I suggest changing EDS analysis; by EDX analysis; through the manuscript.
(**A5**) We changed EDS to EDX in the manuscript.



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(**Q6**) Both, in the abstract and in the introduction authors state particle composition was analyzed using TEM which is not entirely correct. Use of EDX and SAED needs to be noted.
(**A6**) We added EDX and SAED in the abstract.
*Sizes, morphologies, and compositions of 332 mineral dust particles together with their coatings were analyzed using transmission electron microscopy (TEM) coupled with energy-dispersive X-ray (EDX) microanalyses. Structures of some mineral particles were verified using selected-area electron diffraction (SAED).*

(**Q7**) I suggest adding internal grid for the ternary diagram of Fig 6 to make it mor-ereadable.
(**A7**) We add internal grids in the ternary diagram of Fig. 6.

(**Q8**) page 19252, lines 3-4: references of DeMott et al and Knopf and Koop do not report on CCN activity of mineral dust particles, but rather on their ice nucleation (IN) ability.
(**A8**) We changed the citations to Levin et al., 1996; Yin et al., 2002
Levin, Z., Ganor, E., and Gladstein, V.: The effects of desert particles coated with sulfate on rain formation in the eastern Mediterranean, J. Appl. Meteor., 35, 1511-1523, 1996.
Yin, Y., Wurzler, S., Levin, Z., and Reisin, T. G.: Interactions of mineral dust particles and clouds: Effects on precipitation and cloud optical properties, J. Geophys. Res.-Atmos., 107(D23) 4724, doi:10.1029/2001 jd001544, 2002.

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