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Atmospheric Chemistry and Physics Discussions

Interactive comment on "TEM analysis of the internal structures and mineralogy of Asian dust particles and the implications for optical modeling" *by* G. Y. Jeong and T. Nousiainen

Anonymous Referee #4

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The novelty of this study is the use of focused ion beam milling, an established electron microscopy sample preparation technique in materials science, for the first time for the sectioning of atmospheric particles. This specimen preparation technique allowed the authors to observe internal detail in dust particles, revealing many features that are relevant and interesting for the field of aerosol optics and climate modeling. In general, I like the study because it challenges the naive views that some atmospheric chemists may have about minerals in general and "mineral dust" in particular. 35 thin slices were prepared and analyzed – this number may appear small but the preparation and TEM analysis of these specimens needs a tremendous amount of work and time. To my

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knowledge, such an extensive microstructural characterization has not been done for any rock type, let alone aerosol particles. Since the analyzed particles were selected from thousands of particles that were studied using SEM, the results can be regarded representative of the studied atmospheric dust. The interpretation of the TEM results may not be entirely unambiguous, and converting these new data into information that could be used for modeling aerosol optical properties is far from straightforward. Nevertheless, observations like the widespread occurrence of clay coatings on large grains of other minerals, their oriented arrangements, as well as the pores in the aggregates will likely have significant effects on the optical properties of the particles. The "structural models" put forward by the authors in Figs. 14 to 16 are helpful generalizations that could make the complex results accessible for modeling and remote sensing applications. In summary, the study provides new insight into the characters of large dust particles, and is thus a significant contribution to the body of knowledge on atmospheric dust.

I raised a few points in my first (pre-)review of this paper. For example, I asked about possible sample preparation artifacts that may result from FIB milling, and criticized the lack of electron diffraction patterns for mineral identification. The authors have addressed these comments in the present version of the paper by including a detailed discussion in the experimental section on possible FIB artifacts, and also included several SAED patterns. Therefore, I have only a few minor, technical comments on the present version of the paper.

1) Figure 1 would be more complete if not just clays but all important groups of sheet silicates, such as mica were included among the schematic drawings, especially that muscovite and biotite with submicrometer grain sizes are shown in Fig. 4.

2) In the caption of Figure 5: "(e) TEM lattice 767 fringe image of ISCMs. " – I assume the number 767 appears by mistake. "(f) TEM lattice fringe image of ISCM and chlorite." – please mark chlorite in the image.

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3) Fig. 13. I cannot see any reflections at the positions marked 0.43 and 0.46 nm in the f panel.

4) I wish the authors had cited this paper, which I think is highly relevant to the topic since it was the first to describe crystallographically oriented aggregates of clays on other minerals in atmospheric dust: Díaz-Hernández, J. L. and J. Párraga (2008). "The nature and tropospheric formation of iberulites: Pinkish mineral microspherulites." Geochimica et Cosmochimica Acta 72(15): 3883-3906.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 6619, 2014.