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Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "Chemistry and mineralogy of clay minerals in Asian and Saharan dusts and the implications for iron availability" *by* G. Y. Jeong and E. P. Achterberg

**Anonymous Referee #2**

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This manuscript reports the mineralogy and chemistry of clay minerals in dust particles. Microscopic identification is conducted for Asian and Saharan dust particles using XRD, TEM and EDXS analysis. Mineral composition of bulk samples as well as individual dust particles are reported. Laboratory work is solid and manuscript is easy to follow. However, as discussed below, I have some major reservations and do not recommend the paper for publication in ACP. I believe the journal dedicated to the composition and structure of the Earth will be better suited.

General Comments

Authors are very careless in their definition of dissolved Fe. Iron biogeochemical cycle presents unusual difficulties, as fluxes cannot be described solely in terms of the fractional iron solubility (%Fes). As a matter of fact, from oceanic point of view, and I think this is where the authors are going with this article, %FeS of mineral dust is an irrelevant parameter. Iron can be transported as colloids (defined as < 1 um in diameter), nanoparticles (defined as <0.1 um in diameter) and aqueous species (operationally defined as passing through 0.02 um filter) (Raiswell and Canfield, 2012). So each investigator using different measurement methodologies will report different values. While the data reported in the current paper is consistent with the measurements of Buck and collaborators, it may not be consistent with others (e.g., Baker et al., Cwiertny et al., and many others).

Improved knowledge of mineralogical and elemental composition of clay minerals in dust particles is important. However, previous work has shown that the range in Fe solubility measurements (0.001 to 80%) is considerably higher than the uncertainty in total Fe content. Since authors did not measure dissolved iron directly, no attempt should be made to infer %Fes by comparing Fe/Si, Al/Si, and Fe/Al to limited number of measurements. Such comparison can lead to erroneous conclusions. Moreover, analysis methodology for the data selected for the comparison is inconsistent.

1. Buck et al., 2006 used DI water leaching into pH 3.3 solution. 2. Elemental analysis of Arimoto et al. (2004) are based on ICP-MS and contain no information on dissolved Fe. 3. As far as I can tell, data for Al and Si are not reported in Buck et al. (2010).

Overall, I would like to emphasize that because Fe/Al/Si ratios reported by few authors for "water soluble" fraction agree or disagree with the ones measured in this study tell noting about the sources of the iron and should not be used as a justification that "the dissolved Fe and Al originated from the clay minerals, which suggests that the major source of leached Fe is not Fe (hydr)oxides, but clay minerals."

Unfortunately, I find little of any scientific value in the manuscripts findings related to dissolved iron content of mineral dust. That said though, I think results of the current study could be of interest to geologists. However, if decided to resubmit to more appropriate journal, I think the paper will benefit from comparison to number of studies currently available (e.g., Cwertny et al., 2008).

Specific comments

Pg. 15738, ln 4. Please remove the discussion of Fe complexation. I do not see how organic ligands in seawater can affect %Fes during long-range atmospheric transport.

Pg. 15738 Please include the reference to Johnson and Meskhidze (2013) who looked at the contribution of clay minerals to the total dissolved iron in mineral dust.

Pg. 15770, Fig. 6. Plotting Fe against K could be misleading. As pointed out by Arimoto et al. (2004) considerable amount of K, even during large dust storms, may be attributed to anthropogenic activities. I believe plotting Fe concentration vs. particle diameter (see Cwertny et al., 2008) is more appropriate.

References:

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Cwiertny, D. M., Young, M. A., and Grassian, V. H.: Chemistry and photochemistry of mineral dust aerosol, Annu. Rev. Phys. Chem., 59, 27–51, 2008.

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