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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Mapping the physico-chemical properties of mineral dust in western Africa: mineralogical composition" *by* P. Formenti et al.

Anonymous Referee #4

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This paper deals with the important question of African dust mineralogy and its according provenance. Optical properties are derived from the composition. Fractional iron solubility is estimated from mineralogy as well as measured in some cases.

The authors apply a sophisticated combination of microanalysis techniques to their samples collected during several field campaigns in Western Africa. The data from this study will clearly help constraining mineralogical composition and its variability for African sources.

Subject and paper are suitable for publication in ACP. Some comments should be an-

swered, as detailed below.

Remarks

My only major remark is that the authors claim to base their provenance studies on back trajectory calculations and satellite imagery, but this is never detailed and no examples are given. It would be great to add for example a map showing the identified source areas by back trajectory calculation for all samples to compare them with the prescribed PSA from earlier investigation (like Chou et al. 2008 have done for their single samples).

10249/5-7. For particles larger than 10 μm under atmospheric turbulent conditions the referred to 'standard' formulas might less than optimal, in particular when considering wind speed fluctuations. The referred Rajot et al. 2008 call their estimates 'preliminary'. Was this inlet ever since characterized?

10254/13-10255/4 and 10256-10257: Soil/dust might be constituted by non-negligible amounts of soluble matter like chlorides and sulfates (e.g., Osada 2013). Can this be excluded here? Osada, K. (2013): Water soluble fraction of Asian dust particles. doi: 10.1016/j.atmosres.2013.01.001

10260/24: On which information does this impression rely? If there was any evidence for dust emission by satellite or other means, it should be stated and, accordingly, PSA3 / PSA4 source dropped from the paper in favor of an NN source.

10261/14-end: If I get it right from the text, data points in Fig. 3 are colored according to their source region. However, a strict division at the 3.0 value at each axis is visible, without a single outlier (except the orange ones). This value of 3.0 is in the text then referred to as distinction criterion. It is hard for me to believe that an atmospheric sample series (measured by methods containing considerable uncertainties in the percent range, as detailed by the authors) can come along without a single outlier. Please comment on that. If the elemental ratios were used (also) for discrimination, the graph

doesn't support really the statement on a provenance-composition link without a more detailed explanation, also of the ancillary data.

10262/7-21 and Fig. 4: Albite and orthoclase are two of the endmembers of the ternary feldspar phase diagram. Though there are not extremely rare species, with respect to former analyses (see the cited Schuevens review and its references) it must be doubted that these two were the only feldspars present in the dust all the time. As XRD calibration factors in Table 1 are listed only for these endmembers, my concern is that the XRD spectrum interpretation was considerably biased by the lacking degrees of freedom with respect to other minerals, i.e. only these two feldspar minerals were allowed. If this was the case, the retrieved mineralogical composition should be considered as an indicative-only model composition.

10264/5-7: As I'm not familiar with the used Fe analysis techniques: can this type of analysis identify only goethite and hematite? What happens when other Fe minerals are present, e. g., magnetite - will they be attributed to one the two or neglected?

10264/22: As elevated Ti contents go along with local erosion, and local erosion probably goes along with larger grain sizes, can the observed lower Ti content in transported dust then be related to a grain size effect by large-particle removal during transport?

10266/13-16: If the size distributions are available also in absolute concentrations instead of relative, by comparing the relative volume/mass loss with the shift in composition from quartz to clays, this argument could be strengthened (if the numbers agree).

10269/1: 'simplified to few minerals, clays, . . .': Please note that there are hundreds of different clay minerals, so the simplification here mainly derives from the usage of the very generalizing notion 'clay'.

10270/19: As the wavelength-position of the absorption bands is given by the crystal structure, why should there be a variation?

10277/27-29: From which database the real part was taken for that paper? If I refer to

mineralogical databases (mindat.org, webmineral.com), the real parts of the refractive indices of the major components for visible light mostly range between 1.53 and 1.57, so the lower values listed here (for the first time) are somewhat surprising.

Corrections

10255/23-25 and Fig. 1: If it is easily possible and you mention it in the text, I suggest marking the measurements with local erosion separately, as it would enhance this (otherwise not too interesting) graph.

10258/21-27: While still no exhaustive assessment, Jeong (2008) has made some points on that. That might be a useful reference here, even though he used Asian dust. Jeong, G. Y. (2008): Bulk and single-particle mineralogy of Asian dust and a comparison with its source soils. doi: 10.1029/2007JD008606

10260/5: Glaccum

10260/7: this mixing?

10261/8-11: Rephrase sentence.

10262/5: diverse?

10262/9: Please be aware that the French 'orthose' is 'orthoclase' in English. Occurs multiple times, e. g., also in Table 1 and Fig. 4 and other Figures

10262/18-20: rephrase sentence.

10263/20: subsets

10264/20: I was not able to find a comment on Ti substituting anything in the referred Chou et al.

10265/7: By combining?

10268/6: weight

10270/16: shows

10278/10: but calcite is also transparent

Table 1: Are the percentages given in parentheses the relative uncertainties? What is given as uncertainty? Please indicate.

Table 2: I suggest dividing the first column from the second and third or using another unit (fraction instead of percent). Maybe first column header could be 'oxide fraction of total Fe'.

Fig. 1: x-axis must be labeled with 'μg' instead of 'μm'. I suggest scaling both axes on same length to produce a square graph. Please indicate whether the dashed line is 1:1 or the calculated regression.

Fig. 3 Caption: should read 'DODO'? If the long paper list in parentheses doesn't contain any new data over the Formenti 2011a/Scheuvens 2013 dataset, it should be omitted. Gray levels are hard to distinguish.

Fig. 11 Caption, line 2: originating?

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 10241, 2014.