

Atmos. Chem. Phys. Discuss., referee comment RC1
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Comment on acp-2022-227

Anonymous Referee #2

Referee comment on "Significant formation of sulfate aerosols contributed by the heterogeneous drivers of dust surface" by Tao Wang et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2022-227-RC1>, 2022

This paper discusses the correlation of atmospheric mineral dust, and heterogeneous chemistry with the lifetime of SO₂ and would give a closer prediction of the formation of sulfate aerosols. Therefore this will be a good addition to our current knowledge in this field of atmospheric chemistry.

I have a few comments and suggestions.

1. Abstract: I think we shouldn't say accurately predict - This is because it is still a prediction. Maybe with near accuracy, some rewording would be good.
2. Authors discuss at several points that the differences of dust surfaces can affect their heterogeneous reactivities. (Under driving factors of dust surface, line 265). Another addition to this section: TiO₂ and other titanium-bearing minerals such as ilmenite showed night-time thermal reactions that involve redox cycling with nitrates, as well as pH dependency.
3. Figure 2: why do some minerals have lower sulfates in the daytime while the others have lower sulfates in the nighttime? Can this be explained with the change of particle pH? what is the pH of each sample before the reaction? Fig 2b shows only the pH after reactions.
4. Is chemistries a real word?
5. Figure 3: why does the reactive uptake coefficient drastically increases after particle acidity reached ~4.5/ 5?
6. For daytime chemistry, did you consider the possibility of the formation of sulfate radicals on surfaces with high Ti content?
7. Figure 5: Why the kinetics has increased drastically after pH 5? within the statistical error, do you see any difference between the aq phase and heterogeneous chemistry?
8. Figure 7: Can you better label the y-axes to explain what % contribution?
Panel b: why does the heterogeneous sulfate contribution for a daytime peak at a certain dust concentration and lowers, whereas it reaches a plateau at night time?
9. Why is more SSA formed during nighttime, but more sulfate is formed during the daytime?