Using a Knudesen cell reactor and ATR-FTIR, Liu et al. investigated the heterogeneous reactions of methylamine (MA), dimethylamine (DMA), and trimethylamine (TMA) with kaolinite (as a surrogate of mineral dust) and the effect of temperature. Both amines and mineral dust are important components in the troposphere, and their reations have not been examined yet. This manuscript fits the scope of ACP well and the results are quite new. The kinetic data present by this work would help us better understand the tropospheric sinks of amines and the aging processes of mineral dust particles. This manuscript can be published after the following comments are addressed:

Major comments:

Line 133-136: Prior to the uptake measurement, the reacton chamber was passivated with amines to reduce/minimize the wall effect. The sample chamber also has some (though smaller compared to the reaction chamber) wall effect. Is this significant compared to the uptake by kaolinite? I believe this can be determined by backgroud experiments in which no dust is depoisted onto the sample holder.

Line 429-438: While I agree with the authors that heterogeneous reactions with mineral dust can be an important sink for these amines in the troposphere, I also two comments: 1) the effect of gas phase diffusion needs to be discussed (Tang et al., 2015), especially for large particles (e.g., mineral dust) and fast uptake (which is also the case in this study); 2) only extreme conditions with very high dust loadings are discussed; to understand the general role of these reactions, the authors should also discuss the lifetimes under typical atmospheric conditions. By the way, the dust loading unit used in this manuscript is μm2 cm-3; while this is convenient to calculate the lifetime using Eq. (16), the corresponding mass concentration (which is more widely used) should also be provided.

Line 467-468: It is stated that physical adsorption takes place between amines and kaolinites, but no direct experimental evidence is provided. As I understand, both Knudsen cell reactor and ATR-FTIR can be use to examine whethere a gas-surface reaction is reversile. I would suggest that another 1-2 figures with experimental data should be included to clarify this issue.

Minor comments:

Line 4: I should suggest that “amines” should be changed to “methylamine, dimethylamine, and trimethylamine (TMA)” to be specific.

Line 24-25: This statement is incorrect. The uptake coefficients were directly derived from the experimental data as discussed in Sections 3.1 and 3.2, and mass accommodation coeffeicients are used to derive enthalpies and entropies (Section 3.3).

Line 49: please also provide the concentrations in pptv.

Line 81: The review paper by Crowley et al. (2010) should also be cited here together with Usher et al. (2003).

Line 312: I believe "γ_{eff}" should be "$\gamma_{eff}/\gamma_{obs}$".

Line 339-343: It should be further explained why the study by Wang et al. (2010a) explained the difference between Liu et al. (2012a) and Qiu et al. (2011). For the current manuscript, it is not clear to me.

Line 457-463: the effects of heterogeneous reactions on the chemical composition and IN activity of mineral dust particles is mentioned here. I do believe that it should also be mentioned in the introduction. Besides, many papers have discussed the effects of heterogeneous reaction on the hygroscopicity and CCN and IN activities of mineral dust, including those by Cziczo et al. (2009), Sullivan et al. (2009), Ma et al. (2012), Tobo et al. (2012) and Tang et al. (2016), just to name a few.

Figure 5: It will improve the readability of this figure to move ΔH and ΔS values to the figure caption instead.

Reference

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