

Interactive comment on “Heterogeneous ice nucleation on dust particles sourced from 9 deserts worldwide – Part 2: Deposition nucleation and condensation freezing” by Yvonne Boose et al.

Anonymous Referee #2

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Boose et al. reports measurements of the effectiveness with which a range of natural dust samples from around the world to nucleate ice from supersaturated water vapour. Various analytical techniques were used to determine the composition of the samples and to attempt to establish what components are responsible for observed ice nucleation, leading to the conclusion that quartz and feldspar content is responsible for the ice nucleation observed in most samples. In one sample organic substances were found to be largely responsible while in another removal of organics actually enhanced ice nucleation effectiveness. The conclusions of the paper are interesting and relevant

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to the scope of ACP, highlighting the substantial complexity in ice nucleation by natural samples. The paper is mostly well written, sensibly structured, and is entirely suitable for publication in ACP, after a few minor corrections

Minor comments

I have a few issues with the identification of feldspar phases via powder XRD in this work. Alkali feldspar structure is a complex topic and it is not clear to me that powder diffraction is adequate to certain about which polymorph is present in dust samples of the type characterised here. Indeed in part 1 of this study the authors state 'Where microcline and orthoclase are present in the same sample, their individual fraction could not be distinguished reliably' in the caption to the relevant table. It is not clear to me what has changed in the present study. The difference between orthoclase and microcline is essentially the degree of order of the aluminosilicate framework. There is not necessarily a hard line between orthoclase and microcline. Parsons et al (*American Mineralogist* (2015) 100 (5-6), 1277-1303) and references therein discuss some of the relevant issues. Additionally the differences between even very pure samples of the two minerals in powder XRD are subtle. It must be more difficult to be certain of phase when mixed dusts with very low feldspar contents are under investigation. In summary, if the statements in the paper regarding the relative amounts of orthoclase and microcline are to be kept a much better description of the powder XRD procedure, and justification the differentiation between orthoclase and microcline is needed. I do not think this is particularly key to the paper, because, as the authors say, there is not any difference between the feldspars as characterised anyway. I would suggest treating the topic as it was treated in part 1 of this study.

Relatedly, Pg 8 line 12 states that microcline is the more active K-feldspar polymorph without citation. I think this statement should be changed, or its origin cited and discussed. The superior ice nucleating ability of microcline seems to be assumed throughout the paper. I would note that Whale et al. (*Phys. Chem. Chem. Phys.*, (2017), 19, 31186) which used pure feldspars '...found no correlation between ice-nucleating ef-

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iciency and the crystal structures or the chemical compositions...’ of ice nucleation active feldspars, albeit in rather different conditions.

Naming of samples is not entirely consistent through the manuscript I think, this should be checked.

Specific comments

Abstract line 7 to 9- sentence starting ‘in this study,...’ does not read well.

Abstract line 9- between 238 and 242K

Abstract line 15 reads poorly, missing comma after ‘diminished’?

Pg 2 Line 2- delete ‘already’

Pg 2 Line 25- ACP version of Paramonov et al. is available

Pg 3 line 32- clumsy wording, probably delete ‘showing’

Pg 3 line 10- typo ‘selected’

Pb 3 line 33- clumsy sentence structure

Pg 3 line 35- ‘over’ not the right work I think.

Pg 3 line 33 onwards- I note that there is interesting work on the topic of ice nucleation by quartz under review in ACPD at current (<https://www.atmos-chem-phys-discuss.net/acp-2018-1020/>), which may shed some light on the complexities of ice nucleation by various silicas.

Pg 4 line 7- while RH is increased

Pg 8 line 15- Some justification for using the conditions stated might aid the reader.

Pg 11 line 15- I’m not sure what is meant by the sentence ‘However, it was not....’. I suggest clarifying this.

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Pg 9 line 15- I am not sure what is meant by 'hardly' in this context? This sentence could be clearer.

Pg 11 line 12- remove comma after 'both'

Pg 12 line 6- brackets around '2006' after 'Laird'

Pg 12 line 10- sentence starting 'Thus, according to our observations...' is clumsy

Figure 2- It is not obvious what the * in 0.63* refers to without referring to final table.

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