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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Ice nucleation activity of silicates and aluminosilicates in pure water and aqueous solutions. Part 2 – Quartz and amorphous silica" *by* Anand Kumar et al.

Anonymous Referee #1

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General comments

This paper examines immersion mode ice nucleation by a range of quartz and silica samples using differential scanning calorimeter technique which allows comparison of different nucleators and solute conditions, concluding that milling processes produce the sites that cause quartz to nucleate ice and that quartz doesn't nucleate ice better in the presence of ammonia, in contrast to feldspar minerals. The paper provides numerous sensible and well-supported suggestions for factors that may affect the effectiveness of quartz and silica and ice nucleators and discusses the complexity of assessing the role of quartz in atmospheric ice nucleation. The paper is admirably

thorough and is well written. The conclusions are within in the scope of ACP and are of substantial interest. While I have a few minor comments that the authors may want to consider I support publication.

Specific comments

I think it is generally agreed that calculation of ice nucleation active site densities is helpful e.g. (Hoose and Möhler, 2012) and a recent intercomparison suggests that comparisons across different instruments is likely meaningful (DeMott et al., 2018). The data produced here and in other papers using DSC provides useful information for internal comparison but it is rather a shame that it does not lend itself to quantitative comparison with other techniques. Would it be possible to calculate ns values from the available data? Some comment on this might be helpful.

Relatedly, the weight percents of quartz used are very high. A 10 wt% suspension is almost like mud and will flocculate and settle effectively immediately. I am curious as to why such high particle concentrations have been used? In addition, the presence of solutes may conceivable change the rate of flocculation and change how the solutions interact with the emulsifying oil. For the comparisons made in this study to be valid the droplets it is, I think, necessary that the droplet distribution across all DSC experiments is very similar. While I recognise that the original paper on the technique paper used up to 20 wt% I still think it would be helpful to have a figure or table somewhere demonstrating that droplet distributions for different suspension compositions are indeed similar, and perhaps some brief comment on how any variation in this distribution may affect results.

The paper is quite long and much of the midsection is a rather turgid. Obviously, this paper is just one part of a very substantial of work, indicating sensible efforts have been made to divide up the vast number of results. However, the authors may want to consider presenting their results more concisely in places. This would aid readability.

Pg 9 line 334-336- The surface area per droplet in Whale et al. is not as large as

10 cmˆ2. The droplets used were smaller than those of Zobrist with a similar particle concentration. I suspect the silica used was simply different in some and that this accounts for the different freezing temperature observed.

Technical comments

Pg 3 line 77 and other places- There is some inconsistency in the citations to the other papers in the Kumar series, a's and b's aren't always present.

Pg 3 line 105- Word missing somewhere in the sentence starting 'Quartz,. . ..'

Pg 4 line 127- remove 'only a mere. . .'

Pg 4 line 138- different number of significant figures on weight loss compared to elsewhere.

Pg 10 line 351-354- This sentence is a little difficult to follow.

Pg 11 line 413- 'Shortly' is the wrong word here, 'briefly' maybe, although it would be better to just state the length of time.

Pg 12 line 436- 'little' is the wrong word. Should be 'few'

Pg 13 line 477- I'm not clear what is meant by 'when quartz is ground in the atmosphere'. This should probably be explained.

Pg 17 line 630- I'm not sure 'deteriorates' is the right word.

References

DeMott, P. J., Möhler, O., Cziczo, D. J., Hiranuma, N., Petters, M. D., Petters, S. S., Belosi, F., Bingemer, H. G., Brooks, S. D., Budke, C., Burkert-Kohn, M., Collier, K. N., Danielczok, A., Eppers, O., Felgitsch, L., Garimella, S., Grothe, H., Herenz, P., Hill, T. C. J., Höhler, K., Kanji, Z. A., Kiselev, A., Koop, T., Kristensen, T. B., Krüger, K., Kulkarni, G., Levin, E. J. T., Murray, B. J., Nicosia, A., O'Sullivan, D., Peckhaus, A., Polen, M. J., Price, H. C., Reicher, N., Rothenberg, D. A., Rudich, Y., Santachiara, G., Schiebel,

T., Schrod, J., Seifried, T. M., Stratmann, F., Sullivan, R. C., Suski, K. J., Szakáll, M., Taylor, H. P., Ullrich, R., Vergara-Temprado, J., Wagner, R., Whale, T. F., Weber, D., Welti, A., Wilson, T. W., Wolf, M. J., and Zenker, J.: The Fifth International Workshop on Ice Nucleation phase 2 (FIN-02): laboratory intercomparison of ice nucleation measurements, Atmos. Meas. Tech., 11, 6231-6257, 10.5194/amt-11-6231-2018, 2018.

Hoose, C., and Möhler, O.: Heterogeneous ice nucleation on atmospheric aerosols: a review of results from laboratory experiments, Atmos. Chem. Phys., 12, 9817-9854, 10.5194/acp-12-9817-2012, 2012.

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