

## Review of “The ice-nucleating ability of quartz immersed in water and its atmospheric importance compared to K-feldspar” by Harrison et al.

### General comment

This study investigated the ice-nucleating abilities of 10 different  $\alpha$ -quartz samples and compare the obtained results with feldspar literature data. The authors found a large variability in the ice nucleation behavior of the 10 samples with some being very efficient (e.g., Bombay chalcedony and Atkinson quartz). It was also found that the ice-nucleating abilities of some of the studied quartz samples were affected by ageing and milling. With the current and literature data the authors produced a new set of parametrizations for quartz and different feldspar. The authors found that the new K-feldspar parameterisation provides a good representation of the ice-nucleating activity of dust from field and laboratory studies. Finally, their analysis show that quartz is of second order importance for desert dust’s ice-nucleating ability.

This is a well written and sound manuscript with interesting results for the ice nucleation community. The experiments were well designed and were properly executed. The paper nicely fits with the ACP scope and it can be accepted for its publication after the following points are properly addressed.

### Major Comment

Although I really like the manuscript, I am having a hard time to find the atmospheric relevance of the obtained results. Given that milling is a process that does not takes place in nature the way it was conducted in the laboratory, I am not fully convinced that the obtained parametrisations can really be used in climate models as the representation of true atmospheric mineral dust particles. Similarly, I also found that the very long ageing times (i.e., > several months) are not atmospherically relevant.

### Minor comments

1. The title states: “The ice-nucleating ability of quartz immersed in water and **its atmospheric importance** compared to K-feldspar”. Can the laboratory experiments be assume to be relevant to the atmosphere? Does milling takes place in the atmosphere and soil the way it was done in the laboratory?
2. The abstract is very descriptive without quantitative data. I suggest to add the most important quantitative results here.
3. The authors indicate that the base line was obtained from Umo et al. (2015). Does it mean that you did not run these type of experiments prior to the heterogeneous ice nucleation ones? How confident are the authors that this did not change since 2015? I suggest to add your own data and to remove the Umo et al. (2015).
4. Section 4.2: Is milling atmospherically relevant at all? Can this happen in nature to this extent? Please motivate this deeply.

5. Conclusions: Although the authors provide potential explanations for their observations, several sentences/conclusions seems to be speculative.
6. References: Add the Doi to all references. The journal names must be abbreviated. I find exaggerated to have 20 citations from the same research group.

## Technical comments

Line 25-26: for ice nucleation.

Line 27: "less active". By how much?

Line 29: "more active". By how much?

Line 51: Add a reference after "incomplete".

Line 54: "Observations of aerosol at the centre of ice crystals have shown that mineral dust". Is it really at the centre?

Lines 54-56: Either state that this sentence focuses on MPC only or add other studies such as Cziczo et al. (2013).

Lines 61-62: I suggest to add the review of Hoose and Mohler (2012) given that this list is too short to reflect the huge amount of work done with clays.

Line 117: Add a reference after "dust aerosol".

Lines 185-186: "and a study of nitric acid hydrate nucleation on meteoric material (James et al., 2018)." It does not fit here.

Line 188: "was vigorously shaken". Manually?

Lines 119-121: "An almost identical method was described by Harrison et al. (2016), which was similar to the work of Wright and Petters (2013)." Unnecessary self-citation.

Line 243: Delete "approximately 1 h later" It is redundant.

Lines 245-246: "There is also consistency for some quartz samples between run to run from this study". This was already mentioned seven lines above: "In the cases of Bombay chalcedony, Brazil amethyst and Smokey quartz, the first and second runs where identical within the uncertainties".

Line 295: "sealed glass vial for". Under dark conditions?

Line 309: "a dark cupboard in sealed glass vials". Why under dark conditions? What atmospheric process does it represent?

Line 316: "by about 3 °C". Do the authors consider this a significant change?

Line 321: "by 2 °C". Do the authors consider this a significant change?

Line 321: "after 16 months in water". Is this atmospherically relevant?

Line 326: "for 20 months". Is this atmospherically relevant?

Line 329: "for ~5 years in a glass vial". Is this atmospherically relevant?

Line 544-545: "quartz, but the parameterisation we present here probably represents an upper limit to its activity." I am wondering if the ice-nucleating abilities of the quartz samples are unintentionally overestimated by milling.