

Interactive comment on “Nucleation of nitric acid hydrates in Polar Stratospheric Clouds by meteoric material” by Alexander D. James et al.

Anonymous Referee #2

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General Comments

The manuscript presents an attracting study on the heterogeneous nucleation of crystalline NAT by meteoric materials analogues. The authors have shown that meteoric material can trigger nucleation in PSCs. The paper is well written and I recommend its publication in ACP.

Specific Comments

My main doubt is concerning to the different ability of the meteoritic material analogues tested to trigger the nucleation. The authors argue that olivine-pyroxene phase dominate the activity, but it looks that the specific surface area of the meteoric materials is also a key factor. According to the results shown, materials which present larger

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specific surfaces areas show less ability to nucleate than those with much less surface area values (larger particles). My question is: what feature (specific surface area or olivine-pyroxene presence) is more important in this process?. In addition, these results sound strange to me, because usually nano-materials are much more efficient in heterogeneous processes as e.g. catalysis. The authors recognize that the explanation of these differences is currently not clear. Nevertheless, they argue that small particles are of similar order to the size of the critical clusters which is not good for nucleation and quote a paper of 1978, but I would like to see more details of such assumption. Also, they argue that relatively small changes in the surface properties of materials may have significant impacts on their nucleation activities. Which surface properties are important?, and also, it is possible to know something more about these relevant surface properties of the materials used? Also, when salts of Fe^{3+} or Mg^{2+} are added, no effect on the nucleating temperatures was observed, in contrast to the study of Wise et al, 2003. Some tentative explanation of this issue should be done. The authors also claim that NAT phase (instead of NAD) is formed directly during nucleation, but not any reference to which crystalline phase of NAT (alpha- or beta-) could be formed. Although, it is not possible to measure it in these experiments, I think that it is important to mention this issue. In fact, in a recent work (Weiss et al. *Angew. Chem. Int. Ed.* 2016, 55, 3276 –3280) it has been shown that the presence of alpha-NAT (instead of beta-NAT) could be the key step to explain the mechanism for NAT formation in high-altitude ice clouds. Although it is not the issue of this paper, the possible existence of different crystalline NAT phases and its relevance in the nucleation process should be mentioned in the paper.

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