Ice Nucleation Active Sites on Feldspar and Quartz

Tobias Zolles[a], Julia Burkart[a,c], Thomas Häusler[a], Bernhard Pummer[a,d], Regina Hitzenberger[b] and Hinrich Grothe[a]*

[a]Vienna University of Technology, Institute of Materials Chemistry, Getreidemarkt 9, 1060 Vienna, Austria
[b]University of Vienna, Faculty of Physics, Aerosol Physics and Environmental Physics, Boltzmanng. 5, 1090 Vienna, Austria
[c]University of Toronto, Chemistry Department, St. George St. 80, ON M5S 3H6 Toronto, Canada
[d]Max-Planck-Institute for Chemistry, Dept. Multiphase Chemistry, Hahn-Meitner-Weg 1, 55128 Mainz, Germany

Mineral dusts originating from Earth's crust are known to be important atmospheric ice nuclei. In agreement with earlier studies, feldspar was found as the most active of the tested natural mineral dusts[1,2]. Nevertheless, among those structures K-feldspar showed by far the highest ice nucleation activity while the Na/Ca-feldspars were not exceptional. In this study, the reasons for its activity and the difference in the activity of the different feldspars were investigated in closer details in combination with studies on quartz. The mineral particles were investigated with scanning electron microscopy, X-ray powder diffraction, infrared spectroscopy, and oil-immersion freezing experiments.

In this poster we give a potential explanation of the increased ice nucleation activity of K-feldspar. We suggest that the ice nucleating sites are very much dependent on the alkali ion present by altering the water structure and the feldspar surface. The higher activity of K-feldspar can be attributed to the presence of potassium ions in the surface and surface bilayer or the absence of sodium or calcium ions. These alkali-ions have different hydration shells and thus an influence on the ice nucleation activity of feldspar surfaces. The influence of the cations had been observed earlier on micas[4]. Chaotropic behavior of Calcium and Sodium ions are lowering the ice nucleation potential of the nucleating feldspars surface, while kosmotropic ions like Potassium have a neutral or even positive effect on the structuring of water molecules.

[1] Atkinson et al.. The Importance of Feldspar for Ice Nucleation by Mineral Dust in Mixed-Phase Clouds. Nature 2013, 498, 355–358.

[2] Yakobi-Hancock et al.. Feldspar Minerals as Efficient Deposition Ice Nuclei. Atmos. Chem. Phys. 2013, 13, 11175–11185.

[3] Zolles et al. Identification of Ice Nucleation Active Sites on Feldspar Dust Particles. J. Phys. Chem *A*, 2015, 119 (11), pp 2692–2700

[4] Shen, J. H et al. C. Ice Nucleation by Micas. J. Atmos. Sci. 1977, 34, 957−960