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Effects of chemical surface modification on the ice nucleation ability of feldspar and illite

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Mineral dust is the most abundant ice nuclei (IN) in the atmosphere and thus it is thought to be important for ice nucleation in clouds (Murray et al. [2012]). The clay minerals contribute approximately two thirds of the mineral dust mass (Atkinson et al. [2013]), and illite is the most abundant clay mineral found in the atmosphere [Broadley et al., 2012]. In the past years a lot of the ice nucleation research focused on proxies for clay minerals like Arizona Test Dust (ATD), kaolinite and illite (see reviews by Murray et al. [2012] and Hoose and Möhler. [2012]). In most experiments, these substances acted as IN only at relatively low temperatures (lower than -25°C). Very recently Atkinson et al. (2013) showed that K-feldspar, which is a common crustal material, is the most active mineral dust with freezing temperatures above -20°C.

In the present study we compared the immersion freezing behavior of size segregated illite and feldspar particles. We used illite-NX (Arginotec) and a feldspar sample from Minas Gerais, Brazil (consisting to roughly 80% of a K-feldspar with the remainder being a Na-feldspar). Both substances were examined in the framework of the INUIT research project. For the illite-NX particles freezing onset was observed at temperatures around -34°C. The feldspar sample already induced freezing at -23°C. The data obtained was in agreement to those reported in Broadley el al. [2012] and Atkinson et al. [2013]. To simulate chemical aging of the particle surface we coated the particles with sulfuric acid and repeated the measurements. The illite-NX showed a rather small change in the ice nucleation ability, whereas the freezing ability of the feldspar was strongly reduced and became similar to that of illite-NX. It seems that the sulfuric acid destroyed those sites on the particle surface which are responsible for the initiation of freezing. We continue our work in trying to better understand what exactly it is that gives K-feldspar its good IN ability.

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