Contribution ID: **17** Type: **not specified**

Application of synchrotron X-ray radiation methods to study alkali feldspar / water interface

Thursday 14 November 2024 09:00 (20 minutes)

"Alkali feldspar is an important constituent of airborne mineral dust, the major source of primary ice nucleating particles (INPs) in the atmosphere. Some alkali feldspars have particularly high ice nucleation (IN) activity. This phenomenon has been recently ascribed to the ability of (100) planes of alkali feldspar to nucleate ice. However, the structure of feldspar-ice interface is not known and therefore the molecular level understanding of ice nucleation on feldspar is lacking.
Recently, we have initiated an interdisciplinary project combining expertise in atomistic modelling, mineralogy, crystallography, atmospheric IN research, electron microscopy and synchrotron X-Ray scattering methods with the goal to achieve molecular characterization of the water-feldspar interface prior and during the nucleation of ice crystals. In this contribution, we focus on the application of synchrotron X-Ray scattering methods for in-situ measurements of ice formation on cleaved planes of microcline feldspar in a custom-designed environmental cell. The preliminary results obtained at P08 beamline at DESY support our previous hypothesis of the epitaxial relationship between the prismatic plane of ice and the (100) crystal plane in feldspar, initially formulated from the electron microscope observations. We discuss the potential development of this method and the implications of these findings for the future atmospheric IN research.
We also briefly discuss the results of a recent XPS-NEXAFS study probing the hydrogen bonding structure of interfacial water in the presence of ions, removed from the sub-surface mineral framework by cation exchange. We show that the presence of foreign ions apparently inhibits the formation of tetrahedrally coordinated water upon adsorption on the sample surface, making water structure more "liquid-like". The interpretation of both X-Ray diffraction and spectroscopic results is supported by direct measurements of the IN efficacy of feldspar specimens performed in a droplet freezing array setup.

Acknowledgement: we acknowledge FWF and DFG for financial support (project number 515700978) and support by PETRA III P08 beamline stuff scientists Florian Bertram and Chen Shen (DESY). David Heuser, Elena Petrishcheva, and Prof. Rainer Abart (University of Vienna) are greatly acknowledged for sample preparation and characterization, and for general guidance."

Significance

Presenter: KISELEV, Alexei (Karlsruhe Institute of Technology, Institute of Meteorology and Climate Research)

Session Classification: Solids and solid interfaces