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Water ordering and freezing behavior on Feldspar affected by exposure to liquid water

Content

Feldspar minerals are important substrates for the nucleation of ice in the atmosphere. While parameterizations are available that describe freezing behavior for a range of different minerals, the understanding of why some substrates are ice nucleation active and some others are not, is not very good at the molecular level. In this work, we used partial electron yield near edge X-ray absorption fine structure (NEXAFS) spectroscopy to assess the hydrogen bonding structure of adsorbed water on two different Feldspar minerals, a microcline and an orthoclase. Ambient pressure X-ray photoelectron spectroscopy revealed strong surface enhancement of potassium upon first exposure to water vapor for the microcline sample. In turn, upon immersion of this sample into liquid water for 24h led to a potassium depleted surface, but in parallel the NEXAFS spectra showed an increased presence of tetrahedrally coordinated water molecules. The orthoclase sample showed exactly opposing behavior. Parallel droplet freezing experiments, repeated freeze - thaw cycles led to an increase and decrease of the freezing efficacy, respectively.

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