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X-Ray spectroscopy of frozen salt solutions: Are inclusions solid or liquid below the eutectic temperature?

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Natural ice in clouds and on the Earth surface contains many impurities, such as salts or acids. The chemical reactivity of these substances is defined by the thermodynamic state of the impurity. In ice, impurities may be in a solid or liquid. Moreover, impurities may be accumulated in confined reservoirs, such as grain boundaries or triple junctions. In these reservoirs premelting might occur. Hence salts may be in a liquid-like environment, even below the eutectic temperature.

Using synchrotron based X-Ray absorption and fluorescence spectroscopy we study the physical state of salt ions in ice, which was frozen from dilute salt solutions. Using XANES and EXAFS we can determine whether the salt ions in the ice are in a solid or a liquid state.