



## **A 3D X-ray micro computer tomography perspective of sea ice, frost flowers and snow as sources of reactive halogens**

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Springtime ozone depletion events (ODEs) in the polar troposphere have become a recognized phenomenon. Ozone depleted air masses are associated with passage over newly-formed sea ice on which frost flowers are often produced. Due to their high salinity from wicking up brine solution and their large specific surface area, they are thought to be a potentially significant source of reactive halogens to the atmosphere. Further, frost flowers might also constitute a significant source of sea salt-aerosol, with direct implications for the interpretation of corresponding ice core records. Similarly, the same also applies to fresh snow falling on new sea ice, which can also wick up brine resulting in a high salinity and a large surface area. In all cases, potential source strengths will depend on the concentration and spatial distribution of the sea salt components in the sea ice, frost flowers, and snow. Based on 3D X-ray computer tomography images generated at the Swiss Light Source synchrotron facility, we visualized the evolution of the brine inclusions in sea ice and frost flowers or snow including crystal growth, capillary flow of brine and ageing (evaporation) of the ice structures.

The results suggest that a brine film highly concentrated in bromide can form on the ice surfaces providing a likely source of the reactive bromide causing ODEs.