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The effect of antifreeze proteins from a polar diatom on ice microstructure

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Microorganisms that populate the brine inclusions within sea ice, exposed to harsh living conditions, shape their environment to their convenience. The diatom Fragilariopsis cylindrus, a dominant species in sea-ice assemblages, reacts by changing the physical properties of ice. These organisms produce extracellular antifreeze proteins (AFPs), which seem to play a key role for their survival in ice. Antifreeze proteins from F. cylindrus affect the microstructure of ice, changing grain size, shape and influencing c-axes orientation. Furthermore, AFPs affect crystal growth by inhibition of migration recrystallization. Within sea ice, AFPs may interplay with exopolymeric substances (EPS) in locally decreasing ice permeability, increasing the volume of brine inclusions and therefore the diatoms' living space.

We present results of a deepened analysis of ice microstructure in the presence of AFPs from F. cylindrus, observed by light microscopy. The elucidation of the interaction between AFPs and ice crystals is relevant not only to understand biological processes within sea ice, and how biology shapes sea-ice structures, but is of interest for potential industrial applications of AFPs.