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Ginzburg-Landau theory for the early phase of morphogenesis of brine channels in sea ice — •Silke Thoms[1], Bernd Kutschan[2], Klaus Morawetz[2,3], and Sibylle Gemming[4] — [1]Alfred Wegener Institute for Polar and Marine Research, Am Handelshafen 12, D-27570 Bremerhaven, Germany — [2]Münster University of Applied Science, Stegerwaldstrasse 39, 48565 Steinfurt, Germany — [3]International Institute of Physics (IIP), Universidade Federal do Rio grande do Norte - UFRN, Brazil — [4]Helmholtz-Zentrum Dresden-Rossendorf, PF 51 01 19, 01314 Dresden, Germany

The web of brine channels in sea ice is the natural habitat for many psychrophilic microorganisms and influences the heat exchange between the ocean and the atmosphere. Especially the sea ice texture depends on the salinity and the temperature. The first structures emerging during sea-ice formation are determined by the phase instability of the ice-water system in the presence of salt. We apply a Ginzburg-Landau type approach to describe the phase separation in the two-component system (ice, salt). The free energy density involves two fields: one for the hexagonal ice phase with low salinity, and one for the liquid water with high salinity. From the free energy functional two coupled partial differential equations are derived for the time evolution of the phase field (ice) and the second field (salt). The equation of motion differs for the non-conserved order parameter (ice, whose spatial integral may vary with time), and for the conserved chemical compounds (salt, whose spatial integral is constant). The partial differential equations are solved numerically in one and two dimensions.

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