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Influence Of Air Bubbles In Ice On Grain Growth

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Normal grain growth, driven by grain boundary surface energy, is usually assumed to be one of the most important processes in the upper levels of polar ice caps. The ice in these levels contains bubbles of trapped air. We used the numerical modeling platform ELLE1,2) to model the effect of air bubbles on grain growth in ice. ELLE is mainly a 2D model. In this simulation we used the front tracking method with different properties for each phase boundary. Currently the ice-air boundary energy is set at eight times that of ice-ice boundaries, giving a dihedral angle of 173°. Grain boundary mobility is set to be equal for all boundaries. These settings allow the air bubbles to stay round due to the high wetting angle. A series of simulations were run with initially equal mean sizes for ice grains and air bubbles and varying air bubble content.

In the simulations mean grain size of ice crystals increases with time, due to the disappearance of small, few-sided grains. Mean air bubble size increases at a much slower rate, as growth only occurs by merging of bubbles. Bubble-free grain aggregates show a linear increase in mean grain cross-sectional area. First simulations with a total bubble area of up to 20% and the current parameter settings, show little effect of bubbles on the grain growth rate. This is surprising since one would normally expect that the air bubbles act as pinning objects that would interact with ice grain boundaries and eventually bring grain growth to a halt. However, air bubbles are not inert pinning particles but also evolve over time. Another factor that may play a role are the relative mobilities of ice-ice and ice-air boundaries and which are currently under investigation.

(1)Bons, P.D., Koehn, D., Jessell, M.W. (Eds) (2008) Microdynamic Simulation. Lecture Notes in Earth Sciences 106, Springer, Berlin. 405 pp.

(2)Jessell, M.W., Bons, P.D. (2002) The numerical simulation of microstructure. Geol. Soc, London, Spec. Publ. 200, 1137-147.