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Geometry and crystallographic configuration of grain boundaries

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Ice cores provide a unique opportunity to study fundamental mechanisms which control the internal flow of ice sheets. Different kinds of deformation processes acting on the micro-scale are responsible for the viscoplastic behavior on large scale. Careful interpretation of microstructural features such as grain size, shape, lattice orientation and the occurrence of subgrain boundaries can help us to follow these processes and to improve our understanding of ice rheology.
Polarized light microscopy experienced a quick development in the last decade. A new generation of automatic fabric analyzers enables to measure c-axis orientations in μm-resolution. This high amount and quality of fabric data motivates to apply digital-image-processing routines (DIP) for the recognition and quantification of microstructural patterns.
Here we present a study on grain boundaries based on the acquisition of more than 700 fabric images recorded along the NEEM ice core (Greenland). Geometrical characteristics of grain boundaries are studied as well as their cross-sectional orientations in relation to the c-axis orientations of the corresponding adjacent grains. We could follow the evolution from the initial N-type and P-type low-angle boundaries (Weikusat et al., 2011) to high angle boundaries during rotation recrystallization. In agreement with some previous studies we confirm that the established three-stage-recrystallization model may be an oversimplification. According to our results, rotation recrystallization as well as grain boundary migration are actually present in all depths with varying intensities at NEEM.

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