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Microstructural evidence for complex multi-scale deformation in the EastGRIP ice core

Content

We present the microstructure, focusing on the grain boundary network and bubbles, from more than 1000 thin section samples from the East Greenland Ice Core Project (EastGRIP) ice core that is being drilled at the onset of the North East Greenland Ice Stream since 2017.

The data were recorded directly at the drilling site with a Large Area Scanning Macroscope from the polished and sublimated surface of samples from between 0 and 2121 m ice depth. Most samples are cut vertically to the core axis but a selected number of horizontal sections are included, providing the opportunity to attempt a three-dimensional reconstruction of the microstructure. Processing of the image data was done with the open source software Ice Image Analyser, extracting a fully digitalized grain boundary network by applying machine learning for the classification of grain boundaries and air inclusions.

We analysed the shape-preferred orientation (SPO) of grains and bubbles based on statistically computed parameters from the data set under consideration of available azimuthal core-orientation data reconstructed from visual stratigraphy data. These SPO parameters include grain size distribution, grain shape and derived measures like perimeter ratio and aspect ratio, and grain boundary orientation angle.

The data show varying trends throughout the core and on different length scales, supporting earlier observations in the crystallographic-preferred orientation data from the same set of samples. We provide microstructural evidence for dynamic recrystallisation driven by deformation throughout the core. Specifically, we will discuss our findings of heterogeneities that point to internal deformation due to the occurrence of high strain localisation and link them to the observed complex pattern of anisotropy in the ice column.

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