Geophysical Research Abstracts
Vol. 15, EGU2013-4789, 2013
EGU General Assembly 2013

Combined transmission and reflection optical microscopy of ice core sections

Tobias Binder (2), Ilka Weikusat (1), Thomas Kerst (2), Jan Eichler (1), Anders Svensson (3), Pascal Bohleber (4), Christoph Garbe (2), and Sepp Kipfstuhl (1)

(1) Alfred Wegener Institute, Glaciology, Bremerhaven, Germany , (2) Interdisciplinary Center for Scientific Computing, Universität Heidelberg, Germany, (3) Niels Bohr Institute, Ice and Climate Research, University of Copenhagen, Denmark, (4) Institut für Umweltphysik, Universität Heidelberg, Germany

Microstructure analysis of ice cores is vital to understand the processes controlling the flow of ice on the microscale. To quantify the microstructural variability (and thus occurring processes) on centimeter, meter and kilometer scale along deep polar ice cores, a large number of sections has to be analyzed. In the last decade, two different methods have been applied: On the one hand, transmission optical microscopy of thin sections between crossed polarizers yields information on the distribution of crystal c-axes. On the other hand, reflection optical microscopy of polished and controlled sublimated section surfaces allows to characterize the high resolution properties of a single grain boundary, e.g. its length, shape or curvature.

Based on a polar and an alpine ice core we applied both methods to the same set of sections. This enables us to combine all information on crystal orientation and (sub-)grain boundaries. In this contribution we introduce the method of combined transmission-polarization and reflection microscopy as well as an image processing framework for processing and matching both image types [1]. The information content of both analysis methods is limited and influenced by different types of artifacts. It is exemplary shown how the combination allows to compensate for deficiencies of one method.

The gray values in images of the grain boundaries on polished ice core sections are influenced by the duration of surface sublimation and the energy/misorientation of the grain boundaries in the section. By combining these gray values with the misorientation obtained from the corresponding thin section imaged between crossed polarizers we try to validate the information content of gray values on the basis of large data sets. This approach is compared to X-ray Laue diffraction measurements (yielding full crystallographic orientation) which validated the sensitivity of the surface sublimation method [2].

As microscopy in transmission mode acquires volume information and microscopy in reflection mode gains information on the surface, an “optimal” matching of both images contains displacements of grain boundary sites. We try to quantify this inaccuracy which can also be interpreted as orientation of the grain boundary surface in 3D.

[1] T. Binder et al., 2013, Journal of Microscopy, in review
[2] I. Weikusat et al., 2011, Journal of Glaciology, 57, 111-120