

Report for Workshop

TTT2012 - Texture Topics in Tromsø

October 15 - 19, 2012, Tromsø University

(1) Summary

From October 15th to 19th the second Texture workshop was held at the University of Tromsø. The workshop started with a two day hands-on introduction to the CIP method followed by a three-day expert meeting focusing on texture and microstructure analysis of ice. The workshop brought together geologists and glaciologists studying ice and other geomaterials deformed under a variety of natural and experimental conditions.

Participation was international with students and researchers coming from more than ten different universities. Discussions profited from the different approaches to texture analysis as practised in the different research communities. The lectures were given by Renée Heilbronner, Gill Pennock, Martyn Drury, Ilka Weikusat, Holger Stünitz and Rüdiger Kilian (from Basel, Utrecht and Tromsø Universities as well as the Alfred Wegener Institute, Bremerhaven) and covered techniques of orientation imaging, texture development, misorientation analysis, sub grain and grain boundary formation, influence of texture and microstructure on the rheology, dependence on deformation mechanisms, etc.

An invited talk by Kenny Matsuoka (Polar Institute, Tromsø) sparked additional discussion concerning the future of structural research and the building of stronger networks among the separate lines of research (field work, drilling programs, microstructure analysis, mechanical experimentation and numerical modelling).

(2) Scientific content - Discussions

The first two days of the workshop were dedicated to the CIP method (computer-integrated polarization microscopy), a method for the calculation of c-axis orientation images and pole figures from polarized input images. Participants were introduced to this technique, the theoretical background was given, and the CIP software was demonstrated. A first set of input data was processed. Orientation images, misorientation images and orientation gradient images (all with respect to the c-axis) were derived and interpreted. Three participants selected a project which they have to complete such that they can acquire 5 ECTS point from Tromsø University. Most of the practice material consisted of input data sets derived from experimentally or naturally deformed quartz, one data set was derived from columnar ice.

The third day comprised an in depth introduction (with exercises and discussion) into texture analysis as carried out through electron microscopy. The concept of (full) misorientations was introduced and methods for analysis were demonstrated. The dependence of texture formation on recrystallization and deformation processes was discussed in detail and the resulting grain and subgrain boundary populations were examined.

The fourth day was primarily dedicated to ice. Insights into research programs concerning the physical properties of ice of the Alfred Wegener Institute and the Helmholtz Gemeinschaft were given, including the special technical problems associated with drilling, sampling, sample preparation and preservation. Various methods for microstructure and texture analysis of ice were discussed. In as much as polar ice deforms in a high temperature deformation regime, the comparison with the grain boundary migration recrystallization of geological materials sparked a number of interesting discussions. In the afternoon, a comprehensive review of texture studies was given, including the use of texture analysis to deduce the type of dislocations and to infer

slip systems.

The morning of the fifth day showed means to integrate the CIP method and EBSD analysis. The PrinCIPia and mtex software were introduced and participants were shown how to calculate orientation images from both optical and EBSD input, how to transfer data from one platform to the other, how to derive misorientation histograms and profiles, and how to scale and plot pole figures. Problems associated with defining and measuring texture intensity (texture 'strength') were discussed, and an alternative way (orientation tracking) for the quantification of texture development was outlined.

(3) Impact and future directions

The majority of the participants of the workshop were structural geologists who did not have their own experience with ice textures. As a consequence, the general discussions on texture and texture formation were based on results derived from a number of materials other than ice, including quartz, halite and olivine. The special problems associated with texture measurements and interpretation in ice were discussed separately. Collateral studies of ice and quartz, and the different approaches taken by glaciologists versus structural geologists provided interesting insights and may prove to be a fruitful approach for both research communities.

In the final discussion session, on Friday, general prospects (international programs) for texture and microstructure research were discussed and the importance of collaborations among research groups was emphasized. The field of microstructural and texture research was seen as a growing field; advances are expected from the integration of field and experimental studies and numerical modelling. The support by microDICE was again gratefully acknowledged and participants were encouraged to try and organize more workshops such as this one.

(4) Final Program

Monday, 9.00 - 12.30

Introduction to Texture Analysis and Orientation Imaging.
Renée Heilbronner

Monday, 13.30 - 17.00

Lab course: Computer integrated polarization microscopy (CIP).
Renée Heilbronner

Tuesday, 9.00 - 12.30

Lab course: c-axis Orientation, Misorientation and Orientation gradient Images.
Renée Heilbronner

Tuesday, 13.30 - 17.00

Lab course: Texture based microstructure analysis.
Renée Heilbronner

Wednesday, 9.00 - 12.30

Mesotextures: misorientations and grain boundary populations.
Gill Pennock

Wednesday, 13.30 - 17.00

Textures, deformation and recrystallization processes.
Martyn Drury

Thursday, 9.00 - 12.30

Textures and microstructures in polar ice.
Ilka Weikusat

Thursday, 13.30 - 17.00
Texture interpretation and slip systems.
Holger Stünitz

Friday, 9.00 - 12.30
Interfacing CIP and EBSD & Introduction to mtex / MATLAB
Renée Heilbronner, Rüdiger Kilian

Friday, 14.15 - 15.15
"Peering into deep blue ice using radar: achievements and challenges"
Kenny Matsuoka (Seminar)

Friday, 15.30 - 17.00
Future venues for texture and microstructure research on ice.
Open discussion

(5) List of lecturers (6)

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| Renée | Heilbronner | Universität Basel |
| Gill | Pennock | Universiteit Utrecht |
| Martyn | Drury | Universiteit Utrecht |
| Ilka | Weikusat | Alfred Wegener Institut |
| Holger | Stünitz | Universitetet i Tromsø |
| Rüdiger | Kilian | Universität Basel |

(6) List of participants (12)

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| Kerstin | Drivdal | Universitetet i Oslo |
| Jan | Eichler | Alfred Wegener Institut |
| Julien | Fauconnier | Universite Pierre et Marie Curie |
| Loic | Labrousse | Universite Pierre et Marie Curie |
| Björn | Larsen | Norges teknisk-naturvitenskapelige universitet |
| Livia | Nardini | Universitetet i Tromsø |
| Sina | Marti | Universität Basel |
| Antonio | Pelegrina | Høgskolen i Gjøvik |
| Adina | Racoviteanu | Université Joseph Fourier |
| Bettina | Richter | Universität Basel |
| Leif | Tokle | Universitetet i Tromsø |
| Virginia | Toy | University of Otago |