Image analysis of EBSD maps taken from ice core samples

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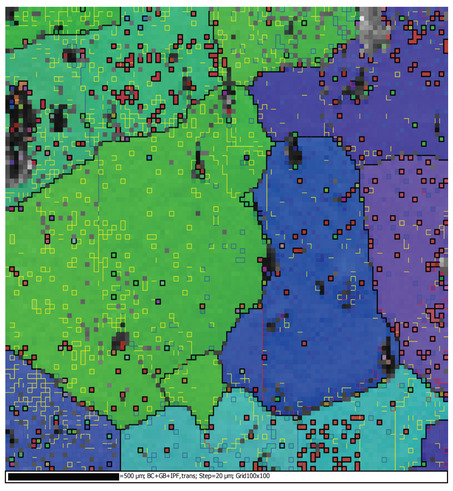
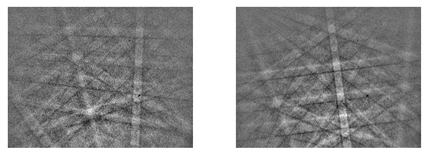
1. Objectives

In this poster we show the techniques used for preparing and analyzing electron backscattered diffraction (EBSD) maps made from ice core samples.

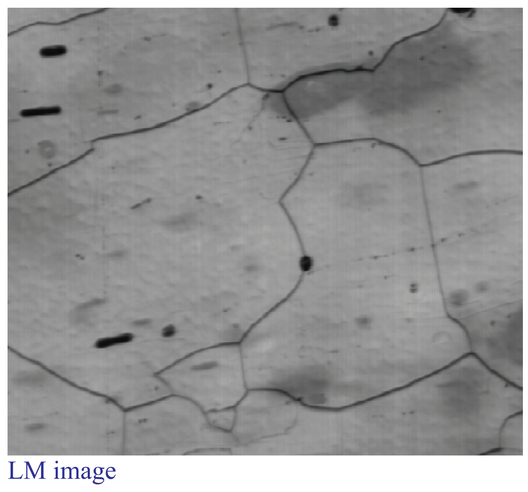


EBSD map before performing noise reduction and using the orientation averaging filter.

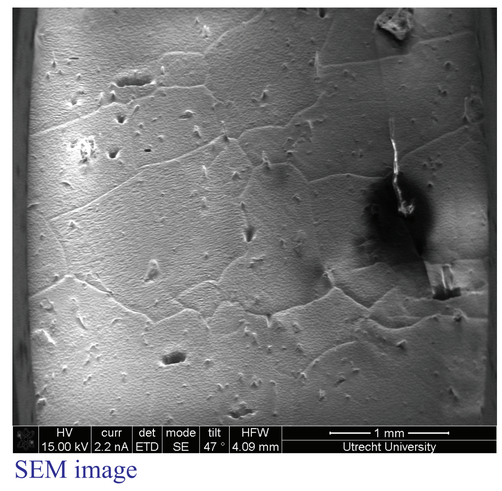


3. EBSD mapping

Oxford instruments HKL Channel 5 system was used to collect and analyse the EBSD maps.Typical condtions were 15 kV and 2.4 nA and a stepsize of 8-25 µm: indexing rates were 50-90%. Two typical EBSP patterns are shown above. Map contains some misindexed gridpoints and very low angle misorientations that are not microstructure. The data is improved by using an orientation averaging filter, giving an angular resolution of 0.5°.



LM image

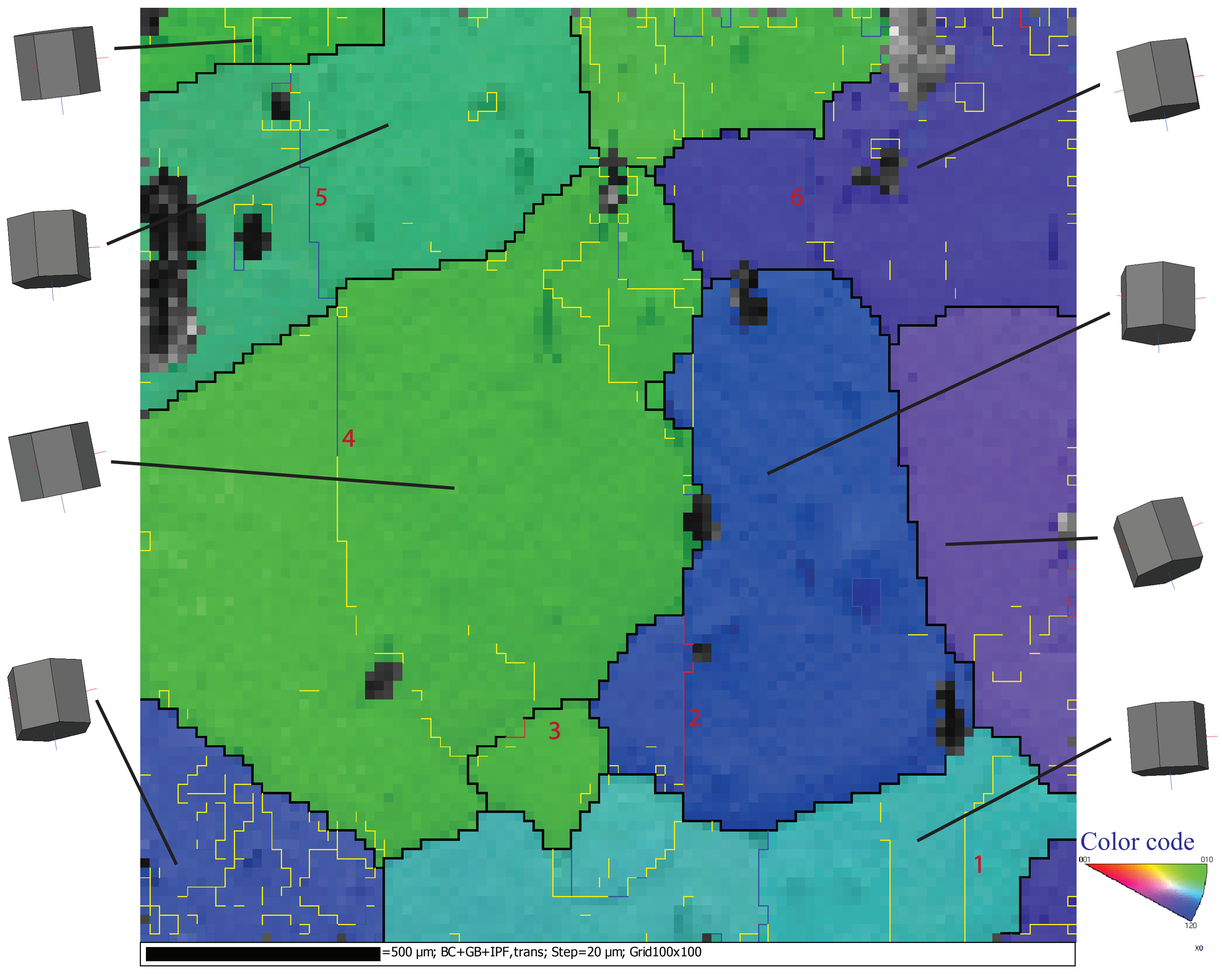


SEM image

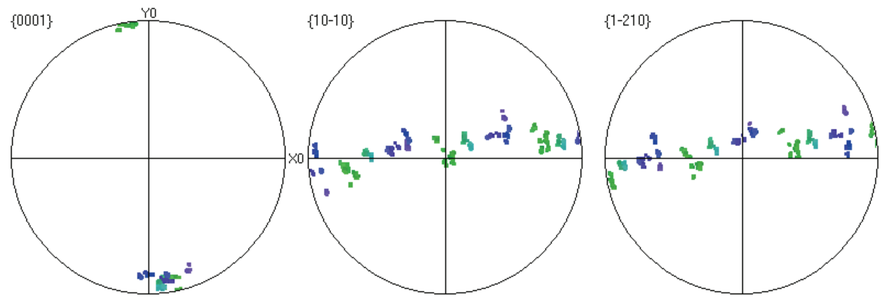
2. Sample preperation

Samples are prepared from the NEEM ice core in the cold lab (-20°C) in Bremerhaven. After microtoming the sample surface (parallel to the core axis) a light microscope (LM) image is taken. This LM image can later be compared to the image taken in the scanning electron microscope (SEM) to see whether the sample surface remained stable during transport and storage at Utrecht University.

4. NEEM ~1767 meter depth

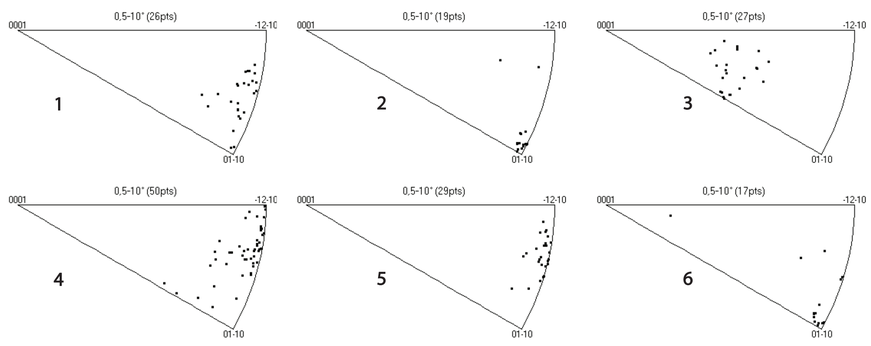


EBSD map showing crystal orientation in different colours (legend: black non indexed) and boundaries between crystals (lines: yellow 0.7°-2.0°; red 2.0°-4.0°; blue 4.0°-6.0°; black <6.0° misorientation). The top of the ice core is the top of the map. On the sides of the map the 3D crystal orientation is shown.



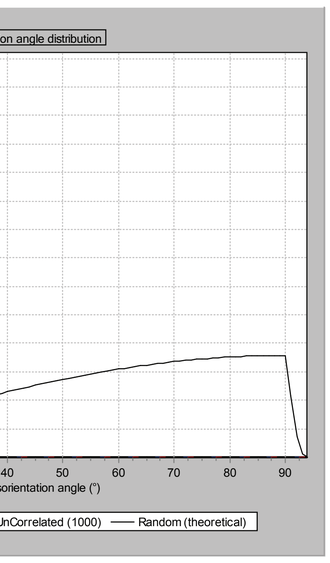
5. Pole figure

Equal area, upper hemisphere projection of the complete EBSD map. A clear vertical clusting of the c-axis can be seen, while the primary prismatic (a-axis) and the secondary prismatic axis are spread over a band in which the purple and green seem to be seperate clusters for the <a> axis.



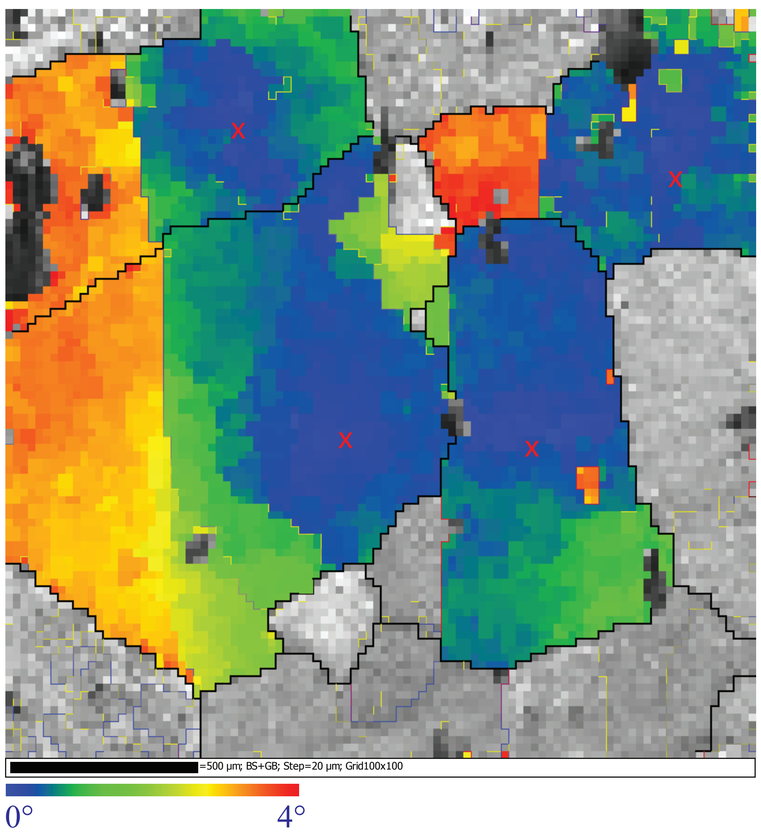
6. IPF figures

IPF figures show the rotation axes (0.5-10°) in crystal coordinates of six different subgrains indicated by number 1-6 in the map to the left. The rotation axis of the slip systems in this EBSD map are the a-axis (sGB 2 and 6), the basal plane (sGB 1,3 and 5) and an arbitrary rotation axis.



7.

Misorientation angle distribution between adjacent grid points (correlated), random pairs of grid points (uncorrelated) and the theoretical curve for a system of hexagonal structures (bin width 5.0°, lower cut-off 4.0°). The correlated and uncorrelated are similar indicating that the misorientations are dominated by the texture.



8. Relative texture component

This map shows the relative texture for four grains in this EBSD map. The coloring depends on the misorientation of the grid cell compared to the reference point in the grain (indicated by the red x). The spread in rainbow color blue to red indicates a misorientation change of 4° with respect to the reference point. The map shows lattice bending in some subgrains.

references:
- Weikusat et al, 2010, Cryogenic EBSD on ice: preserving a stable surface in a low pressure SEM. Journal of Microscopy, 242, 295-310.