Sub-structure characterization of experimentally and naturally deformed ice using cryo-EBSD.

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Abstract: In this work, we present first results of high-resolution EBSD for ice with a spatial resolution down to 0.25 microm. The study highlights the potential of EBSD to significantly increase our understanding of deformation and annealing processes associated with the build-up of internal stresses due to strain incompatibility between grains. Two polycrystalline samples were analyzed: a natural sample of polar ice from the Vostok ice core (Antarctica) and an experimentally deformed sample of laboratory grown columnar ice. In summary, we observe the following: (1) inhomogeneous deformation through the grains is translated into lattice distortions that are concentrated mainly at grain boundaries and triple junctions (natural and experimental sample), (2) these distortions may be continuous (natural and experimental sample) or may form distinct tilt boundaries and sub-grains of 10-50 microm size (experimental sample). These form mainly by rearrangement of basal edge dislocations into low-energy configurations (i.e. tilt boundaries) in various prism planes. Continuous lattice distortions originate from screw or mixed edge and screw dislocations lying in the basal plane.

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