The Cryosphere Discuss.,
https://doi.org/10.5194/tc-2020-2-AC2, 2020

The Cryosphere Discussions
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Interactive comment on "Temperature and strain controls on ice deformation mechanisms: insights from the microstructures of samples deformed to progressively higher strains at −10, −20 and −30 °C" *by* Sheng Fan et al.

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Received and published: 15 June 2020

We thank Reviewer 2 for his thoughtful and helpful review of our paper. The comments have helped us improve the manuscript significantly. Our reply to reviewer comprises two parts: (1) some short general statements and (2) point-by-point reply to comments from reviewer. Please refer to supplement PDF for point-to-point reply.

Section one: general statements

1. This work contains data which are completely new. We would like to thank the

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Discussion paper

reviewer for one particular comment: “This paper essentially presents a nice set of experimental data. . . . the authors provide a detailed analysis of the microstructure of ice grains and its evolution. . .”. We would like to emphasize that the sequence of microstructures and CPOs developed with increasing strain has not been documented before for ice deformed at cold temperatures (-20, -30 °C).

2. The reviewer suggests rejecting this paper mainly because the interpretation of grain boundary sliding (GBS). In our view, interpretations are not usually what make a scientific good paper. New data that is factually correct and will stand the test of time make a good paper. It is likely that the interpretations will change in the future as researchers gain new data or insight. We accept that the factual observations that we present and then to infer GBS could be interpreted in different ways. In the revision, we include some alternative interpretations (including “spontaneous” nucleation) of the data, with some discussion of the merits and drawbacks of each of these interpretations. We hope that we have kept the observations and interpretations clearly separated and we have reduced the emphasis on our preferred interpretation of GBS. We have also identified some of the tests that may facilitate distinguishing these different interpretations in the future. Some more details are included in answers to specific points.

The reviewer’s comments highlight that our original manuscript did not really make clear that we do interpret intracrystalline dislocation glide that causes lattice rotation as one of the key processes controlling CPO development. We hope that we have made this much clearer in the revised manuscript. The operation of a GBS process, if this is correct, would be additional to the role of intracrystalline dislocation glide and associated recovery and recrystallisation processes.

Please also note the supplement to this comment:
https://www.the-cryosphere-discuss.net/tc-2020-2/tc-2020-2-AC2-supplement.pdf

Interactive comment on The Cryosphere Discuss., https://doi.org/10.5194/tc-2020-2, 2020.