

## ***Interactive comment on “The grain size(s) of Black Hills Quartzite deformed in the dislocation creep regime” by Renée Heilbronner and Rüdiger Kilian***

**Anonymous Referee #1**

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The manuscript ‘The grain size(s) of Black Hills Quartzite deformed in the dislocation creep regime’ by Renée Heilbronner and Ruediger Kilian is part of a study, which re-examines shear experiments on Black Hills Quartzite (BHQ) using EBSD analysis. This part of the study, presents EBSD based grain size analyses of samples previously analyzed using the CIP (computer-integrated polarization microscopy) method. Additionally, different segmentation methods (CIP, full crystallographic orientation – EBSD, and let’s call it ‘CIP – EBSD’; i.e. only information on c-axis orientation extracted from EBSD) are compared and discussed. The manuscript presents some interesting conclusions on the dependence of recrystallization grain sizes on factors as the texture and strain rate.

General comments: The two main parts of the manuscript (1. recrystallization grain size of BHQ and 2. comparison of segmentation methods) are not presented in the best

C1

possible way. Starting with the title, which is indicating that this manuscript is on the grain size of BHQ, while big parts are actually on image analysis and the comparison of different segmentation methods. Additionally, results that are interesting for this study are presented in the companion paper (section 4.4 this manuscript). The way the manuscript is written at the moment, a more analytical/method based title would be more appropriate.

A reorganization of the manuscript could be useful. Section 2.2 (EBSD data acquisition) should be a section on its own or combined with section 3 instead of 2 (Selected deformation experiments). Section 3.1 (Pre-processing), 3.2.2 (Procedure to obtain CIP boundaries) and 3.3 (Construction of grain size maps) could be shortened by referring to the book of Heilbronner and Barrett (2014) or moved into the Appendix. Results on grain size analysis (Figure 13) that belong to the result section 4.1 are presented in section 5.3 instead. The result section is quite short and seems incomplete. Some results that are discussed later on are not presented at all (line 550, sample w965).

For big parts of the manuscript ‘CIP’ is used for EBSD based CIP segmentation. Only in section 5.1 EBSD-CIP analyses are referred to as EBSD analysis, while CIP are here suddenly ‘classical’ CIP. This mixing of notations should be changed to make it easier for the reader to follow.

I feel that it might be better to combine both manuscripts (Heilbronner and Kilian, Kilian and Heilbronner the same volume) and move sections and informations on image analysis into the appendix, referring to the book of Heilbronner and Barret (2014). Another option would be to separeate parts on BHQ grain size(s) and add them to the companion paper while summarizing parts on comparison of optical light microscopy CIP and ‘CIP – EBSD’, together with different segmentation types and accuracy of resulting grain sizes from this manuscript in an analytical method based manuscript.

More detailed comments:

Abstract

C2

Line 26 Typo, insert 'to' before the kinematic framework

Introduction Line 67 remove 'or'

Selected deformation experiments Line 102 Define th0

Line 115 Add reference (Heilbronner and Tullis, 2002, 2006).

Line 122 Section 2.2 EBSD data acquisition does not belong to section 2. Selected deformation experiments. You could rename your current section 3 in 'Data Processing' and move your 2.2 into 3.

Line 126 The abbreviation CIP has been introduced earlier. Replace computer-integrated polarization microscopy by CIP.

Line 127 Repetition from introduction line 53, where you already mention that details can be found in Heilbronner and Barrett (2014).

Line 129 Doesn't the chemical polishing remove several nm to  $\mu\text{m}$  of the sample surface? To what extent does this influence the results presented here? My experience is that even a few minutes of chemical polishing can result in quite some difference of the thin section. Of course the statistical grain size analysis should result in similar (or even identic results) but I would expect local changes in grain boundary appearance and maybe even crystallographic orientation. So, to what extent can you really compare c-axis orientation images by CIP and EBSD and grain boundary maps?

Line 145 Delete 'mostly'

Image analysis

3.1 seems to only be important for CIP analysis and not EBSD. This is also the case for 3.2.2. 3.3, 3.4 and 3.5. You should outline somehow which parts of the 'Image Analysis' are relevant for CIP and which ones for EBSD. Also, you could reorganize the section in one part on 'data processing/image analysis for EBSD' and one for 'CIP'.

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Line 172 Remove the brackets.

Line 211 Rephrase and remove the brackets.

Line 261 Does this section refer to EBSD and CIP grain boundary maps? Or CIP only since you can use MTEX to calculate grain size maps from EBSD data.

Line 284 Delete '(as mentioned above)'

Line 286 Refer to figure 3 and table 4.

Line 291 Remove the " from 'the'.

Line 315 Delete the brackets.

Line 316 What do you mean by Figure 6 and c? (Typo?)

Line 342 Check 'intragranular density'. Do you mean the intragranular misorientation density?

Results

Line 358 Delete 'as shown in' from (as shown in Figure 5, inset).

Line 411 Delete the brackets and rephrase.

Line 415 Delete 'finally'.

Line 420 'are' is missing before plotted.

Discussion

Line 434 to 446 Here you seem to be describing optical light microscopy CIP while it was before EBSD based CIP all the time.

Line 449 Delete 'so called' and insert reference Heilbronner and Tullis (2006) instead.

Line 453 Delete the brackets.

### C4

Line 454 Replace 'as shown in figure 11 for sample w965' by (Figure 11, sample w965).  
Line 489 Space missing after 'note'  
Line 490 Typo true/strue  
Line 490 Remove brackets ( $\gamma \sim 3$ )  
Line 489 Typo  
Line 500 gamma effective subscript  
Line 524 Typo, about  
Line 529 Delete (simplified m'-factor).  
Line 540 Typo 'gradients of'  
Line 542 Rephrase and delete the brackets.  
Line 532 to line 544 Recrystallization results in the reduction of the internal strain energy of a grain. Therefore, recrystallized areas should have a low and not high internal misorientation. Please discuss your observation on correlation of intragranular misorientation and grain size more detailed.  
Line 550 Delete or show the results for w965.  
Line 575 Typo, enhance the contrast.  
Line 592 and 593 Delete the brackets.  
Line 640 Brackets  
Line 641 Brackets  
Line 735 Typo, repetition.  
Line 750 Delete 'the' before kinematic.

## C5

### Conclusion

Line 778 What about the possible dependence on strain rate you describe in the discussion? You should add this aspect to the conclusions as it is an interesting one.

Line 1261 Typo, gray (in line 1117 it is 'grey').

### Tables

Table 1 should be moved into the Appendix. Change outline, in row 8 'yield' is covered by border.

Table 2 should be moved into the Appendix.

Table 4 mention/explain the highlighted (pink/red) rows in the figure caption. Explain your a) b) c)

### Figures

The font size in the diagrams and histograms (axes) is too small and probably won't be readable in the manuscript. Be consistent with the layout of your figures. Sometimes you have the sample name as insert in the histogram sometimes above, sometimes the number of analyzed grains is listed then again not, and sometimes the mode is given above the histogram or as insert.

Figure 2 upper right, information on scale bar are missing.

Figure 3. Figure caption seems bit chaotic. Should be organized in a better way. At the beginning you write segmentation based on full texture EBSD, c-axis texture and shape (CIP) but actually you present maps and grain sizes derived from EBSD data with and without grain completion and c-axis (derived from EBSD data) based maps and grain sizes. Legend for colour coding is missing.

Figure 4 Change scale bar to be consistent. All other maps have a black scale bar. Give information which segmentation type you used in figure caption.

## C6

Figure 5 Give information which segmentation type is the basis for the grain sizes.

Figure 13 This figure belongs into the result section rather than discussion.

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Interactive comment on Solid Earth Discuss., doi:10.5194/se-2017-30, 2017.