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Solid Earth Discussions

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5, C224–C227, 2013

Interactive Comment

Interactive comment on "Short wavelength undulatory extinction in quartz recording coseismic deformation in the middle crust – an experimental study" *by* C. A. Trepmann and B. Stöckhert

Anonymous Referee #2

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Comments on the manuscript: "Short wavelength undulatory extinction in quartz..." by Trepmann and Stoeckhert.

The manuscript describes a series of experiments, which were carried out on vein quartz under a set of different temperature, pressure and strain rate conditions. The experimental set-up is chosen to test for the potential preservation of high stress microstructures during later viscous deformation at lower stresses. The approach is novel, innovative, and the results are very interesting. The text is written concisely and clearly. Thus, the manuscript requires only minor revision before publication in its

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final form.

Specific points of content or presentation:

Line 116, 289: the piston does not remain stationary as there is stress decrease and creep in the specimen. It is not moved actively by the motor. There are several passages in the text like this.

Lines 152-154 and 157-159: Unfortunately, there are no stress-strain curves in this paper. Figure 2 is only a force-displacement curve. It would help the reader if there could be a figure with stress-strain-curves rather than always referring to just the table (table 1). In Fig. 2, the hit point (∼35 kN in Fig. 2) corresponds to 4 GPa if a 3.3. mm piston diameter is considered. At a nominal confining pressure of 2 GPa this would mean 2 GPa static and dynamic "friction". This is very high – is this correct?

Lines 158-163: It seems that there is some inconsistent data in Table 1 and Fig. 2. Expt. CR1-17 in Fig 2a shows a total axial shortening of 600 microns (at high stress loading). At a sample length of 7 mm this corresponds to an engineering stain of ∼9 %. Of course, apparatus distortion, etc. has to be considered, but does that amount to a correction to <1% strain as indicated in Table 1 for this expt.?

Line 163-165: The underestimation is only valid for measuring the sample strain directly from the sample after the experiment, not for the record presented in Fig. 2.

Lines 167-169: It should be mentioned briefly that the friction correction cannot be applied to the creep stage, because the piston movement is reversed during increase of the confining pressure – I assume this is the reason?

Lines 184-186: The papers by Tonge et al. 2012 and Kimberley et al. (2010) describe a somewhat different mechanism for unloading crack formation, namely the difference in the Poisson effect between the steel piston and the sample. This results in cracks subparallel to the shortening direction (and crystallographically oriented) in their quartz samples, whereas the unloading cracks in these samples are in the typical orientation

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normal to the shortening direction. The mechanism for the formation of this type if unloading crack (normal to the shortening direction) is given in FitzGerald et al. (1991) and Stunitz et al. (2003): Due to strain inhomogeneity, parts of the sample deform permanently by crystal plastic mechanisms, others mainly elastically. When the sample is unloaded, the elastically deformed parts of the sample expand more than the more plastically deformed parts and cause those to crack (the local geometry is not substantially different from the process described in Tonge et al. 2012). Thus, the location of the unloading cracks bears interesting information on the local distribution of plastic deformation of the sample. This information may be used for some of the discussion of the microstructures in Figs. 3, 5, and 6 (cracks may play the same role as plastically deformed parts of the sample).

Lines 186-189: In Fig. 3 it is not clear how the light micrograph is oriented with respect to the misorientation image. The yellow rectangle of the FIB section is marked in the SEM image (c), not the light micrograph. The two images (a and c) do not show the same sections because the scales are different, but they are similar locations, according to the figure captions (?).

Lines 228-230: It is not so clear that the regions with different dislocation densities are separated by dislocation walls. They seem to be just different dislocation density regions adjacent to one another in Fig. 9b. Similar microstructures were described by Morrison Smith et al. (1976).

Line 343-344: yes, and Stunitz et al. 2003 for feldspar.

Lines 389-391: Deformation lamellae may be preserved, though.

Some detailed and merely technical points:

Line 17: “first” instead of “firstly” line 54: rephrase: “. . .on the microscopic scale...” line 95: “Experimental procedures” instead of “Experimental strategy” line 125: rephrase: “. . .of the confining medium. . .” line 128: a more appropriate reference would be:

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McLaren (1991): Transmission electron microscopy of minerals and rocks; Cambridge University Press line 158: refer to Fig. 2 instead of Table 1 line 226: Fig. 8f is missing line 297: “in the light microscope” instead of “on optical scale” line 354: rephrase: “. . .original grains in between. . .” lines 355-357: rephrase: “New grains show a . . ., whereas dislocation density. . .” line 360: rephrase: “SWUE requires. . ., whereas deformation bands. . .”

The following references are missing from the reference list or there is a discrepancy between the title and author list in the text and the reference list: Ben-Zion & Rice 1997, Stipp et al.. 2002, van Daalen et al. 1999, Ben-Zion 2008, FitzGerald & Stunitz 1993

Interactive comment on Solid Earth Discuss., 5, 281, 2013.