response to comments by T. Gerya: This rebuttal is organized along the reviewer's comments. Our response is directly given "in italic font" after a specific point.

General Comments

This is an interesting and timely paper providing experimental constrains on quartz-water interaction based on hydrothermal grooving experiments. The paper is well written has important implications for a range of natural processes and is suitable for the publications in SE after minor improvements and clarifications proposed below.

We are grateful for the benevolent assessment.

Specific comments

P. 612. Eq.2. Factor 1/2 is not needed (?) in the left-hand side (since ALPHA is defined as ALPHA1=ALPHA2=ALPHA and then substituted in the Eq.1)

The reviewer got mislead by our notation. In fact, ALPHA1=ALPHA2=ALPHA/2. We revised the section to clarify the relations among the various angles.

In case the surface properties are independent of the orientation of the crystals, the following relation holds for the two angles at the root (Figure 1)

$$\frac{\gamma_{gb}}{\gamma_s} = \cos \alpha_1 + \cos \alpha_2 \tag{1}$$

with γ_{gb} and γ_s denoting grain boundary energy and surface energy, respectively (Hackl et al., 2012). For grain boundaries intersecting the surface at a normal angle, we have $\alpha_1 = \alpha_2$ and half of the total root angle $\alpha \equiv \alpha_1 + \alpha_2$ coincides with the dihedral angle ψ defined as

$$\cos\left(\psi\right) = \frac{\gamma_{gb}}{2\gamma_s},\tag{2}$$

and commonly used as a quantification of the ratio between grain boundary energy and surface energy (e.g., Bailey and Watkins, 1950; Rabkin et al., 2001). Unfortunately, the use of the term dihedral angle lacks consistency; for example Holness (1992) denotes the total enclosed angle as dihedral angle rather than half of it.

P.614. Line 18. Lacking reaction stoichiometry. Should the reaction be written as SiO2+2*H2O <=> H4SiO4? We corrected the reaction equation. Table 2. High-temperature experiments are performed relatively close (within 50-70°C) to ALPHA-BETTA quartz transition, where some non-linear effects of the lambda transition could possibly become important.

We share the concern of the reviewer in principle but did not notice a change in either the inventory of surface features or the kinetics of their evolution when run temperatures approach the alpha-beta transition.

P.625. "Note, asymmetry is not predicted by any of the Mullins theories. For such grooves and also grooves with steps, extended approaches have to be considered (e.g., Rabkin et al., 2001) that however lack analytic expressions suitable for our fitting exercise. Therefore, we simplistically treat the two groove flanks independently and prescribe the dihedral angle of the analytical expression by the actually observed angle between groove flank and the normal to the flat surface." How much using of this "pseudo-symmetric" approach may affect results? How different are parameters obtained by fitting of two "shoulders" of the same asymmetric groove? Do characteristics of asymmetric grooves deviate strongly from the Mullins theories prediction (e.g. Fig. 10)?

The reviewer brings up a critical subject. We have to distinguish between asymmetry of grooves due to differences in the height level of neighboring grains and due to tilt of the enclosed grain boundary or anisotropy of kinetics parameters. The orientation dependence of the ongoing dissolution-precipitation processes (see Figures 5, 7, and 9) clearly also contribute to the deviations between observed and predicted groove shapes. As a consequence steps in height occur between neighboring grains. The evolution of ideal Mullins grooves does not include transport from one side of the groove to the other and thus groove halves can be treated separately. Yet, transport from one grain to the other will occur when the grain boundary is tilted or kinetics parameters are orientation dependent. Our approach is affected by the inability of measuring the potential tilt of the grain boundary at which a groove is analyzed. We are currently finalizing a numeric study in which we investigated the relation between grain boundary tilt and groove geometry and its evolution for surface diffusion as rate-controlling process. Initial results were already presented in Hackl et al. (2012, acta materialia) including the effect of different diffusion coefficients for the two neighboring grains. For the large dihedral angles characteristic of the SiO₂-H₂O-system, asymmetry remains modest and the temporal evolution of tilted grooves does not deviate strongly from that of straight Mullins grooves but for severely tilted grain boundaries. Thus, our analysis should suite for an order of magnitude estimate. We will add according comments in the manuscript where appropriate.

P. 627. "The apparent activation volumes gained for the various models all range at about $-100 \text{ cm}^3 \text{ mol}^{-1}$ (Table 3), i.e., about four times the molecular volume of quartz. At face value, such large activation volumes are not easily related with any of the discussed processes." It was suggested by Gerya et al. (2004, Phys. Chem. Minerals, 31, 429–455) on the basis of thermodynamic modeling that ALPHA-quartz has a stoichiometry of Si₃O₆, which thus implies 3 times larger molecular volume.

Thanks for this valuable hint! We will refer to the quoted publication noting the possibility that the large activation volumes give some support to the postulated stoichiometry.

P.630. "The range of characteristic healing times deduced from this study (Fig. 15) seems fairly comparable to if not somewhat larger than the field observations." Would be good to

show the range for the field observations in Fig.15. Also, how much the obtained estimates depend on the assumed crack thickness (1 µm in Fig. 15)?

The field observation (i.e., re-occurrence intervals and healing data for source regions of earthquakes) are hard to quantify in a way that would allow us to include them in the plots. To us, it is simply obvious that the order of magnitude of associated time scales correspond and we will emphasize this perspective in the text. We are happy to extend the contents of figure 15 to account for the effect of crack thickness.