Solid Earth

Discussions

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Interactive comment on "Frictional slip weakening and shear-enhanced crystallinity in simulated coal fault gouges at subseismic slip rates" *by* Caiyuan Fan et al.

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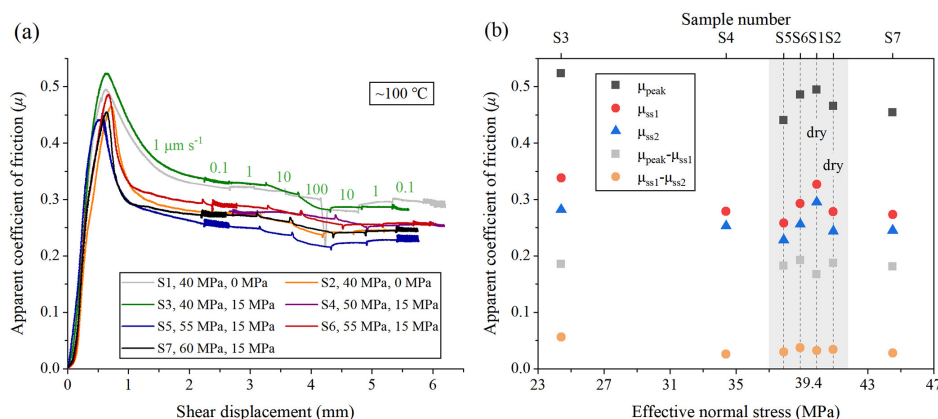Received and published: 19 June 2020

Thanks for your comments. Please see the detailed replies in the Supplement pdf. The figures were also revised following the suggestions.

Please also note the supplement to this comment:
https://se.copernicus.org/preprints/se-2020-43/se-2020-43-AC2-supplement.pdf

Interactive comment on Solid Earth Discuss., https://doi.org/10.5194/se-2020-43, 2020.

C1

Figure 3: Frictional properties of the samples S1–S7 obtained from the velocity stepping experiments. (a) Apparent coefficient of friction (μ) against shear displacement. (b) Apparent coefficient of friction (μ) against effective normal stress. Note that data offset is given in the grey area, i.e. the data plotted on the vertical dashed lines were all obtained at ~40 MPa effective normal stress but are horizontally offset here for readability.

Fig. 1. Figure 3: Frictional properties of the samples S1–S7 obtained from the velocity stepping experiments.
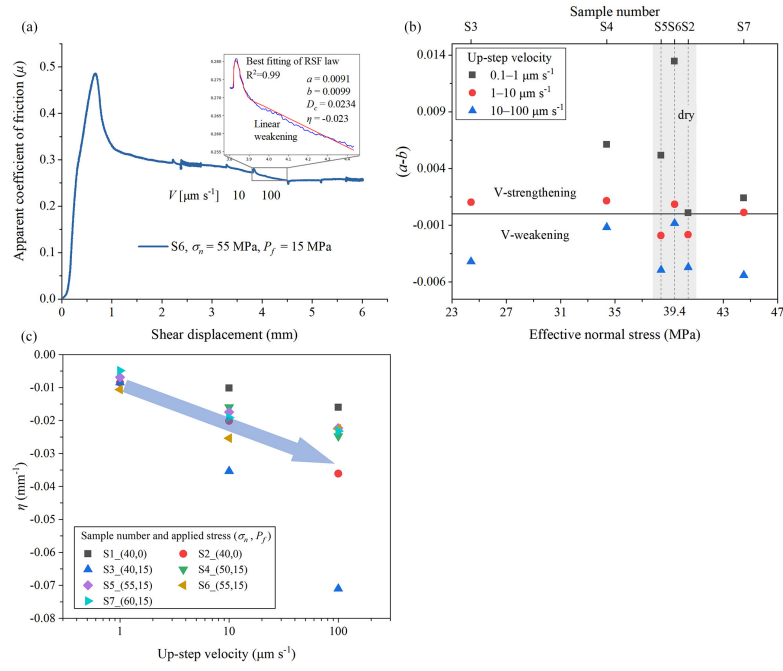
Figure 4: (a) Results of experiment S6, illustrating the best fitting of a full RSF law to the experimental data obtained at the velocity step from 10 to 100 μm s⁻¹. (b) (a-b) values, obtained from upward velocity steps using a full RSF fit, versus effective normal stress at a linear scale. Note that data offset is given in the grey area, i.e. the data plotted on the vertical dashed lines were all obtained at ~40 MPa effective normal stress but are horizontally offset here for readability. (c) The slope η of linear slip weakening trend versus up-step velocity in velocity stepping.

Fig. 2. Figure 4 in the manuscript

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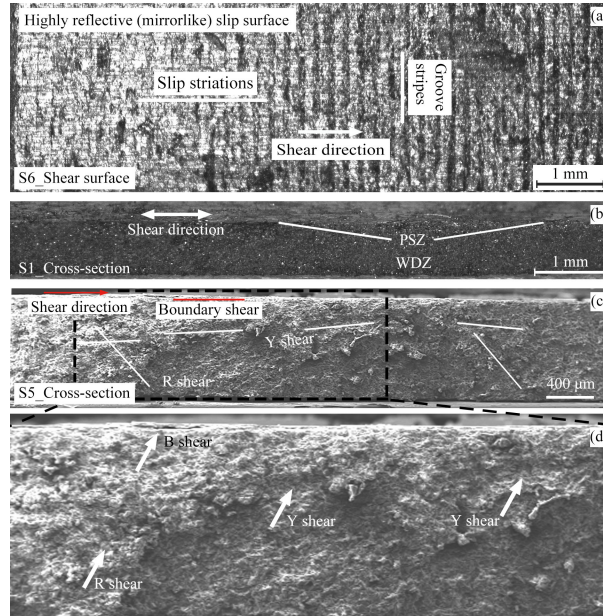
Figure 6: Microstructure of samples S1, S5 and S6 after shear deformation. (a) and (b) were imaged using an optical microscope in a reflected light mode, while (c) was imaged using SEM in secondary electron mode. (a) The shear surface of sample S6, showing a highly reflective (mirrorlike) slip surface on the left hand side of the image (below corresponding label). (b) The cross-section of sample S1 in an orientation parallel to the shear direction, indicating a principal slip zone (PSZ) and a weakly deformed zone (WDZ). (c) The cross-section of sample S5 in an orientation parallel to the shear direction, showing the development of R shear, boundary and Y shear bands. (d) The magnification of the region marked in (c).

Fig. 3. Figure 6: Microstructure of samples S1, S5 and S6 after shear deformation.

C4
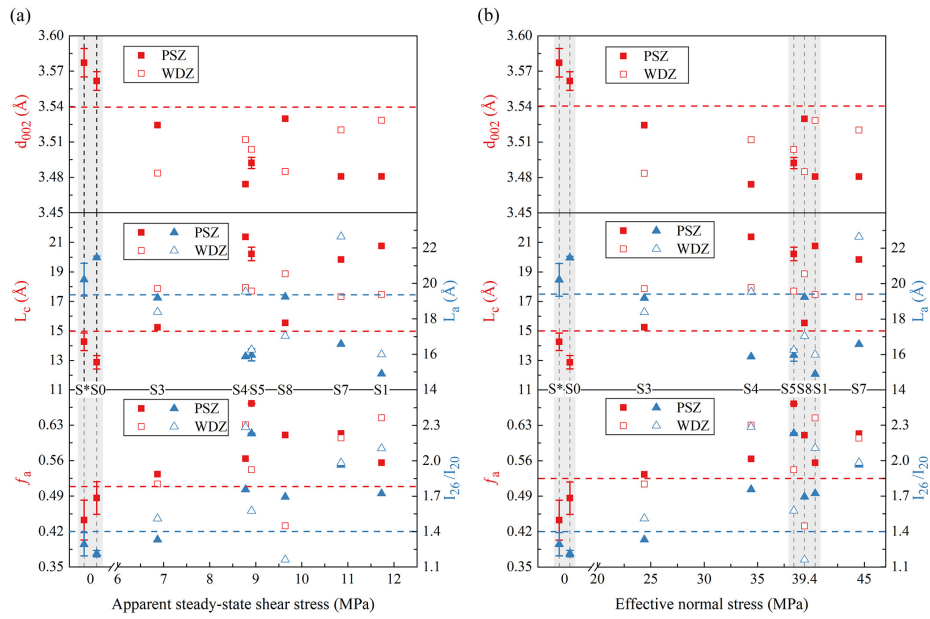
Figure 9: Representative crystal structure parameters obtained from the samples S*–S8 versus apparent steady-state shear stress measured at a shear displacement of ~5.7 mm and effective normal stress with corresponding sample number in (a) and (b) respectively. Data offset is given in the grey area, i.e. the data plotted on the vertical dashed lines were obtained at 0 MPa (non-sheared samples) or ~40 MPa effective normal stress but are horizontally offset here for readability. Solid and hollow squares or triangles represent the values for the PSZ and WDZ retrieved from the sheared samples, respectively. The error bars for samples S*, S0 and S5 are the standard deviations.

Fig. 4. Figure 9 in the manuscript

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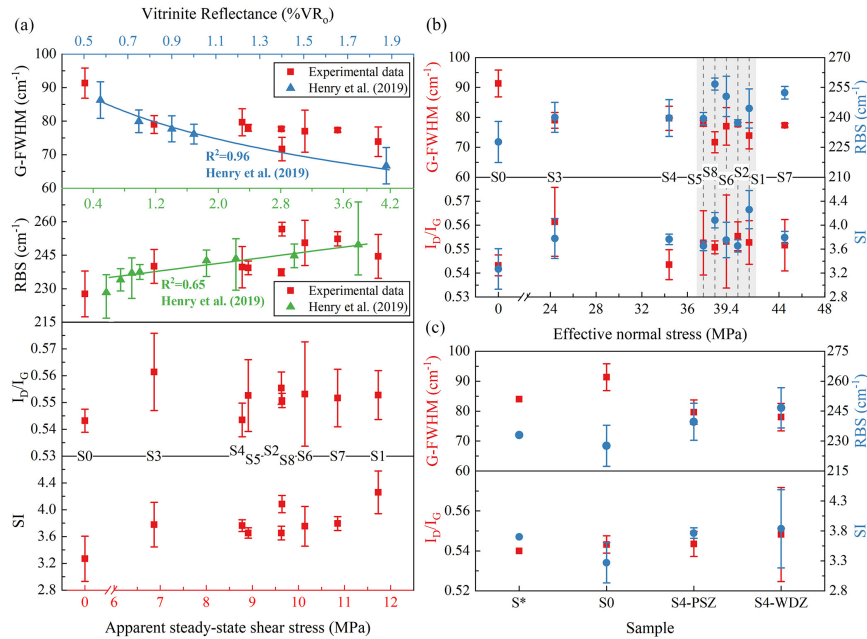
Figure 11: Representative Raman parameters as a function of apparent steady-state shear stress and effective normal stress plotted in (a) and (b) respectively. The difference of Raman parameters between S*, S0, S4-PSZ, and S4-WDZ is shown in (c). In figure (b), data offset is given in the grey area, i.e. the data plotted on the vertical dashed lines were obtained at ~40 MPa effective normal stress but are horizontally offset here for readability. Note that the relation of G-FWHM vs. vitrinite reflectance and RBS vs. vitrinite reflectance plotted in (a) were obtained from Henry et al. (2019). The error bars are the standard deviations.

Fig. 5. Figure 11 in the manuscript

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