GSA Data Repository 2015083

SUPPLEMENTAL INFORMATION

In Figure 2b we show paleo-stress magnitudes based on dynamic recrystallized grain size of quartz mylonites from the Whipple Detachment (Behr and Platt, 2011). This plot is calculated for a normal faulting setting, where $\Delta\sigma = (F'/(1 + F'/2))\left(\sigma_v - \alpha P_f\right)$ (e.g., Zoback and Townend, 2001), and fault normal stress is calculated for a critically oriented fault (which is a function of σ_v and coulomb friction angle). In their published work, Behr and Platt modified the grain size pieozmeter of Stipp and Tullis (2003) to account for a calibration by Holyoke and Kronenberg (2010) of stress magnitude in experiments conducted in a Griggs apparatus. While the concerted effort of Holyoke and Kronenberg provides new insights into stress resolution in the Griggs apparatus, and outlines techniques which can increase the precision of the measurements, we emphasize that the same calibration has not been done on the actual apparatus used by Stipp and Tullis. Furthermore, previous experiments in the same rigs used by Stipp and Tullis indicate strong agreement in sample strengths with experiments conducted on the same material at the same conditions using a gas-medium apparatus (see Figure 3 and 4 of Escartin et al., 1997), which is inconsistent with the Holyoke and Kronenberg calibration. In addition, higher-pressure experiments conducted on quartzite in the rigs used by Stipp and Tullis show the presence of coesite when sigma one exceeds the quartz-coesite phase boundary (see Figure 12 in Hirth and Tullis, 1994); again, this observation is inconsistent with the Holyoke and Kronenberg calibration. Finally, a calibration in another lab, based on olivine dislocation density in samples deformed in both Griggs and gas apparatus, supports the accuracy of the procedures that Stipp and Tullis used to determine stress (see Figure 3 in Ohuchi et al., 2011). In light of these observations, we feel that it was premature to change the piezometric relationship derived by Stipp and Tullis.

Escartín, J., Hirth, G., and Evans, B., 1997, Non-dilatant brittle deformation of serpentinites: Implications for mohr-coulomb theory and the strength of faults, J. Geophys. Res., 102, 2897-2913.

Hirth, G., and Tullis, J., 1994, The brittle-plastic transition in experimentally deformed quartz aggregates, J. Geophys. Res., 99, 11731-11747.

Holyoke-III, C.W., and Kronenberg, A, 2010, Accurate differential stress measurement using the molten salt cell and solid salt assemblies in the griggs apparatus with application to strength, piezometers and rheology, Tectonophysics, 494, 17-31.

Ohuchi, T., Karato, S.-I, and Fujino, K., 2011, Strength of single-crystal orthopyroxene under lithospheric conditions, Contrib. Mineral Petrol. 161, 961-975, DOI: 10.1007/s00410-010-0574-3.

Stipp, M., and Tullis, J., 2003, The recrystallized grain size piezometer for quartz, Geophys. Res. Lett., 30, 2088.

Zoback, M.D., and Townend, J., 2001, Implication of hydrostatic pore pressure and high crustal strength for the deformation of intraplate lithosphere: Tectonophysics, v. 336, p. 19-30, doi:10.1016/S0040-1951(01)00091-9.