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My piezometer is stronger than yours ...

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Recent studies (e.g., Heilbronner & Kilian, 2017, Richter, 2016) indicate that, for general shearing experiments, the quartz piezometer (Stipp & Tullis, 2003) does not correctly predict the recrystallized grain size (from the measured flow stress) or the flow stress (from the measured grain size). One may speculate whether there is an inherent strength difference between simple shear and pure shear deformation, which would then require the calibration of a second piezometer. However, before considering this possibility, it is necessary to ensure that the differential stresses and strains of the coaxial and general shearing experiments are correctly determined.

In this presentation, the focus is on Grigg's type solid medium deformation apparatuses, the general conclusions, however, may apply to other machines and other experimental set-ups too. The major concerns are: (1) How does the force applied externally to the loading piston, in combination with the axially compressed, solid confining medium, translate to the state of stress that exists inside the sample? (2) How much of the sample is homogeneously deforming and how is the strain and the strain rate best quantified?

Coaxial and general shearing experiments carried out in the dislocation creep regimes 1, 2, and 3 (as defined by Hirth & Tullis, 1992) are used to show how the stresses and strains derived from the force-displacement record depend on the choice of mechanical and geometrical corrections. Together with the less than 100% reproducibility of the Grigg's apparatus, the different corrections may lead to a rather large range of results for one and the same experiment, as will be demonstrated. Such discrepancies need to be considered when comparing coaxial and shearing experiments, or when comparing different results from different labs.

With constantly improved machine design, more and more highly resolved data can be retrieved during the experiments. To make full use of these improvements, experimentalists are urged to carefully check the choices made by the software they use (or better still, to write their own software) and to be explicit about the corrections they apply when publishing the resulting stress-strain data. - As the list of calibrations and conversions presented in this PICO is probably not complete, participants of the conference are invited to contribute.

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- Hirth, G. & Tullis, J. (1992). Dislocation creep regimes in quartz aggregates. Journal of Structural Geology 14, 145±159.
- Richter, B. (2016). The brittle-to-viscous transition in experimentally deformed quartz gouge, Basel University PhD thesis.
- Stipp, M., and J. Tullis (2003), The recrystallized grain size piezometer for quartz, Geophys. Res. Lett., 30(21), 2088, doi:10.1029/2003GL018444.