Geophysical Research Abstracts, Vol. 8, 04486, 2006
SRef-ID: 1607-7962/gra/EGU06-A-04486

High-temperature ductile failure of feldspar rocks

E. Rybacki, G. Dresen
GeoForschungsZentrum Potsdam, Germany (uddi@gfz-potsdam.de)

We performed large-strain torsion experiments on synthetic anorthite aggregates with 3μm grain size in a Paterson-type gas deformation apparatus. Specimens with 10 mm diameter and 1-10 mm length were twisted at constant rate to a maximum shear strain of about 5 at experimental conditions of 400 MPa effective confining pressure, temperatures of 950˚C to 1200˚C, and maximum shear strain rates from $1\cdot10^{-5}s^{-1}$ to $2\cdot10^{-4}s^{-1}$. Resulting torques were in the range of 0.3-16 Nm, corresponding to maximum shear stresses of about 2-70 MPa at the sample periphery.

We observed steady-state torques for samples that were deformed at high temperature and/or low twist rate. Strain-rate stepping tests yield a stress sensitivity of about 1, indicating linear-viscous (Newtonian) flow. The mechanical data from high-strain torsion experiments are in good agreement with data from low-strain axial compression tests at similar thermodynamic conditions that suggest grain boundary diffusion-controlled creep. Samples twisted at low strain rates showed continuous strain hardening before sudden catastrophic failure occurred at shear strains of 3-4. However, up to failure no change in stress sensitivity was observed.

All samples showed cavitation and intergranular microcrack growth increasing with shear strain, resulting in sample elongation up to 15%. Cavity nucleation occurred predominantly at grain boundary edges and grain triple junctions. Cavity coalescence produced regularly spaced en echelon fissures mostly oriented about 30˚ to the maximum principal stress. We suggest that cavitation may occur in fine-grained mylonites associated with formation of localized shear bands and leading to catastrophic failure in high temperature shear zones.