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Applicability of flow laws to naturally deformed polyphase rocks

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Small scale shear zones formed in the Gran Paradiso metagranodiorite under lower amphibolite facies conditions (∼550ºC/0.8 GPa LeGoff & Ballevre, 1990; Brouwer et al.,2002). Based on detailed microstructural work the deformation mechanisms of the different rheological phases have been identified. Polycrystalline quartz aggregates deform by dislocation creep (gbm recrystallization), whereas the polymineralic matrix deforms by diffusion creep (Kilian et al., 2011). Iso - stress conditions (Sachs-average) are assumed based on a constant recrystallized quartz grain size and the formation of shear-parallel layers.
Deformed quartz aggregates show higher rotation angle / lower aspect ratio relations, little coalescence, and only minor pinch and swell structures, which altogether suggest that quartz represents the more viscous phase in a somewhat lower viscous matrix. At high strain quartz is completely recrystallized and forms parallel layers with the matrix and does not boudinage.
Experimental flow laws for quartz and feldspar from the literature as well as the theoretically derived flow law for Coble creep with the appropriate parameters can reproduce the observed relation between quartz aggregates and matrix suggesting a strain rate ratio below 2 orders of magnitude. A comparison of data from different granitic rocks deformed between 450° to ∼ 600°C suggests that a combination of a quartz creep law and a Coble creep law can be used for extrapolation at medium grade, natural conditions. These results provide an indication for the range of reasonable flow law parameters and viscosity ratios which are useful for modeling purposes.

References:
Kilian, R., Heilbronner, R., Stünitz, H. Quartz grain size reduction in a granitoid rock and the transition from dislocation to diffusion creep. JSG 33,1265-1284,2011.
LeGoff, E., Ballevre, M. Geothermobarometry in albite-garnet orthogneisses - a case-study from the Gran-Paradiso Nappe (Western Alps). Lithos, 25,261–280,1990.
F. Brouwer, F., Vissers, R., Lamb, E. Structure and metamorphism of the Gran Paradiso massif, western Alps, Italy. Cont.Min.Pet., 143,450–470,2002.