Dislocation creep models of quartz applied to subduction zones

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Dislocation creep of quartz has been extensively studied in laboratories, but the flow law parameters determined for different starting materials and deformation conditions using solid or gas medium apparatus have large uncertainties. This could cause serious errors in extrapolation of the flow laws to natural deformation conditions.

Recently Fukuda and Shimizu (2017, *JGR*) applied theoretical models of recovery creep to quartz deformation and evaluated the flow law parameters using volume diffusion data of oxygen. Creep data of wet quartz, especially those obtained by Luan and Paterson (1992, *JGR*) using a gas apparatus, show a reasonable agreement with a volume-diffusion-controlled recovery creep model of beta-quartz. The theory also predicts significant effects of alpha-beta transition on flow stresses of quartz rocks and possible occurrences of pipe-diffusion controlled dislocation creep at lower temperature conditions. Transition from volume- to pipe-diffusion controlled dislocation creep likely corresponds to microstructural transitions reported for experimentally and naturally deformed quartzites.

Herein we apply the theoretically derived flow laws of quartz to a cold subduction zone in NE Japan and to an ancient hot subduction zone in SW Japan, and estimate flow stresses on the subducting plate interfaces.

Keywords: quartz, dislocation creep, flow stress

