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# Evolution of the rheological and microstructural properties of olivine aggregates during dislocation creep under hydrous

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Since hydrogen plays an important role in dynamic processes in the mantle, we conducted high-strain torsion experiments on Fe-bearing olivine aggregates under hydrous conditions. Most of the samples deformed homogeneously to total shear strains of up to $\gamma \approx 5$. We deformed samples to high enough strain that a steady-state microstructure was achieved, in order to investigate the evolution of the rheological and microstructural properties. The stress exponent of $n \approx 3$ and the grain size exponent of $p \approx 0$ determined from the fitting of strain rate, stress, and grain size data indicates that these samples deformed by dislocation creep. Fourier transform infrared (FTIR) measurements of an imbedded olivine single crystal demonstrated that our samples were saturated with hydrogen during the deformation experiments. The crystallographic preferred orientation (CPO) of the olivine aggregates changed as a function of strain due to competition among the three slip systems (010)[100], (100)[001], and (001)[100]. The observed strain weakening that occurs early in each experiment is to geometrical softening associated with development of a CPO, which reduces the stress by 36% in constant strain rate experiments. The evolution of the rheological and microstructural properties observed in our experiments is important for understanding dynamic evolution of Earth's mantle under hydrous conditions.

Keywords: olivine, deformation, high-strain torsion experiment, hydrous conditions, mantle