# Rheological weakening due to phase mixing of olivine + orthopyroxene aggregates

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To understand the processes involved in rheological weakening due to phase mixing in olivine + orthopyroxene aggregates, we have conducted high-strain torsion experiments on samples of iron-rich olivine + orthopyroxene. Samples with volume fractions of pyroxene, $f_{px}$ = 0.3, were deformed at a temperature of 1200°C and a confining pressure of 300 MPa using a gas-medium apparatus to total shear strains up to γ≈26.
Values for the stress exponent of $n$ ≈3 and grain size exponent of $p$ ≈1 at lower strain (1.9 ≤γ≤ 4.2) and $n$ ≈2 and $p$ ≈3.5 at higher strain (γ ≥24) were determined from a linear least-squares fit to the strain rate, stress, and grain size data using a power-law creep equation. These values of $n$ and $p$ indicate that our samples deformed by dislocation-accommodated grain boundary sliding at lower strain, with an increased contribution of diffusion creep at higher strain.
The microstructures observed in samples deformed to lower strain are consistent with structures induced by a dislocation-accommodated creep mechanism, while the microstructures observed in samples deformed to higher strain are compatible with structures observed following diffusional creep. In samples deformed to lower strain, elongated olivine and pyroxene grains aligned sub-parallel to the shear direction, and dynamically recrystallized grains formed in both phases . In contrast, in samples deformed to higher strains, mixtures of small, rounded grains of olivine and pyroxene were developed. The mechanical and microstructural evolution observed in this study are an important step toward understanding dynamic processes of strain localization and rheological weakening during plastic deformation of the lithosphere necessary for the initiation and persistence of plate tectonics.

Keywords: phase mixing , olivine and orthopyroxene aggregates

 