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Microstructural evolution of peridotite during high temperature deformation

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Large strain deformation experiments in torsion were conducted on a coarse grained natural dunite with a pre-existing lattice-preferred orientation (LPO) at T = 1500 K; P = 300 MPa; and strain rates of $5*10^{-5}$ - $2*10^{-4}$ s^{-1}. The objective of these experiments is to investigate how microstructural evolution occurs when dislocation creep dominates deformation. Hence, experiments were conducted at conditions where deformation by diffusion creep is largely suppressed. Microstructural evolution was studied as a function of strain. We observe that the pre-existing LPO persists to a shear strain of at least 0.5. At larger strains, this LPO is transformed. Relict deformed grains exhibit LPO with [100] crystallographic axes at high angles to the shear plane. Unlike previous experimental studies on finer grained materials, these axes do not readily rotate into the shear plane with increasing strain. Dynamic recrystallization occurs in samples deformed to moderate strains (gamma > 0.5). Recrystallized material forms bands that mostly transect grain interiors. The inhibition of diffusion creep along relict grain boundaries may account for the relatively large strains required to observe evolution of microstructures. Our data support assertions that microstructures may record a long and complicated deformation history. Relationships between LPO, seismic anisotropy, and deformation kinematics may not always be straightforward.