

Supplementary material for
“Evidence of phase nucleation during olivine diffusion creep: A new perspective
for mantle strain localisation”

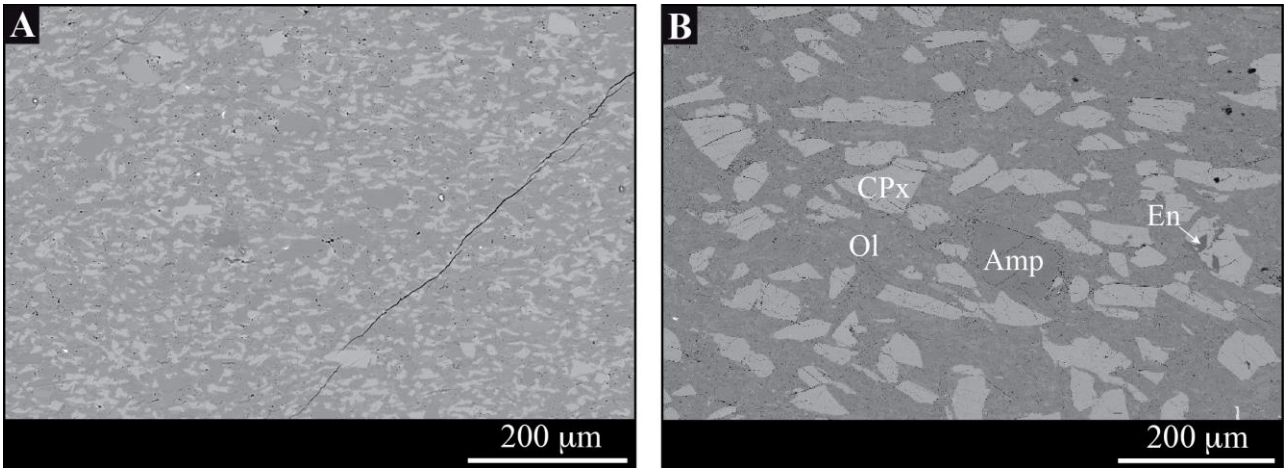
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Content

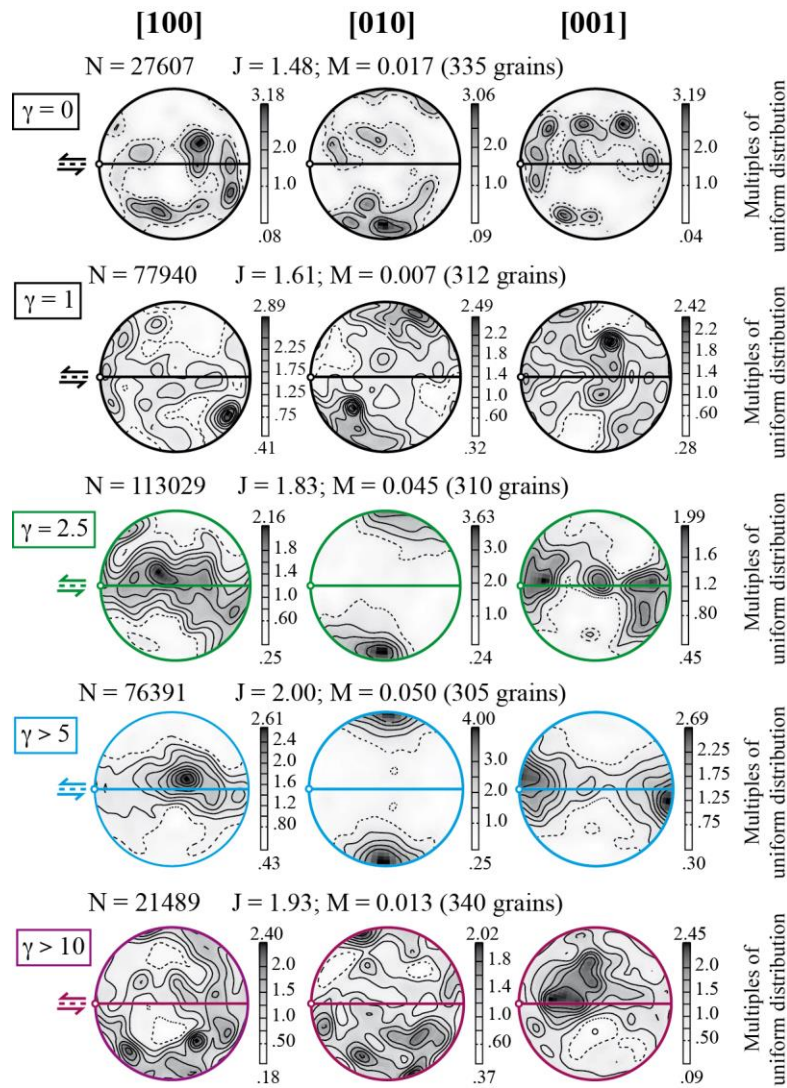
- Supplementary figure 1: Starting material
- Supplementary table 1: Parameters of deformation experiments
- Supplementary figure 2: Olivine Lattice Preferred Orientation (Map-based)
- Supplementary figure 3: EBSD map of the pure olivine sample



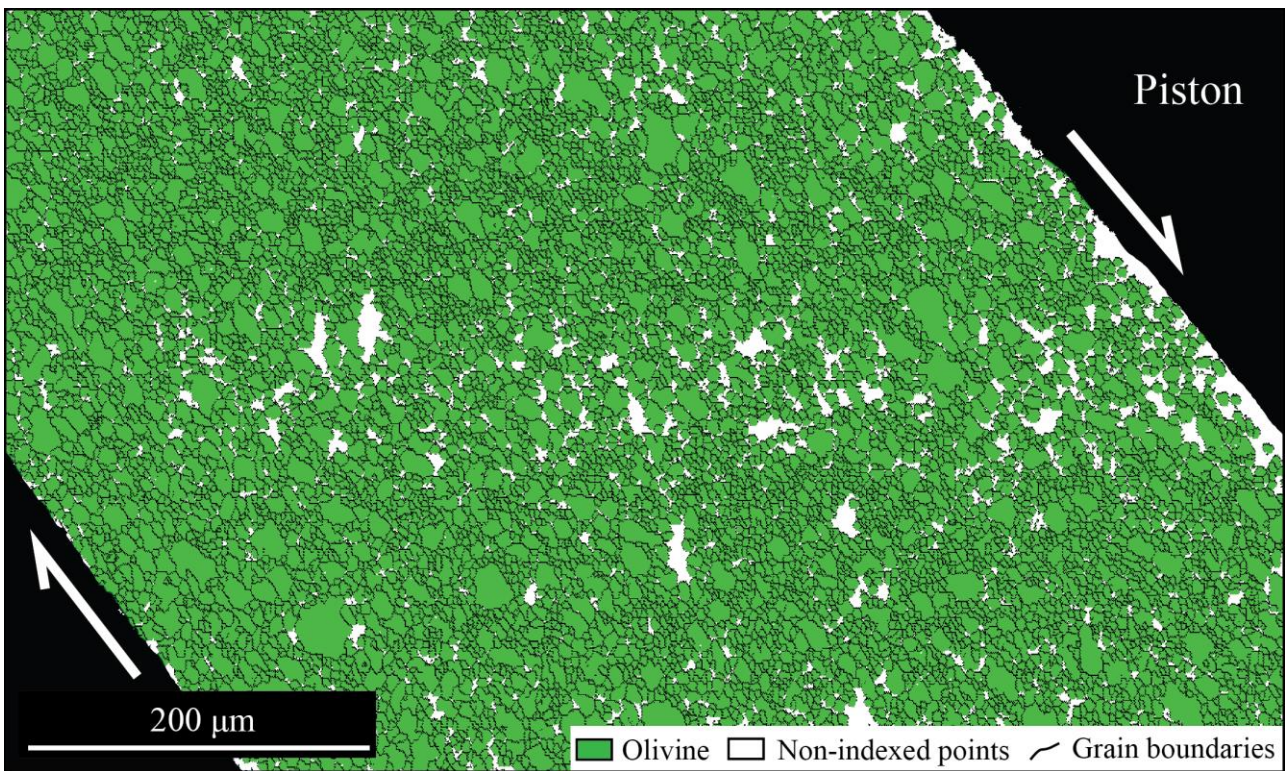
Supplementary figure 1 | Starting material – A) Starting material (after hot-pressing) of a two-sample with fine-grained CPx. B) Starting material of two-phase sample with coarse-grained CPx. CPx = clinopyroxene; Ol = Olivine; Amp = amphibole; En = enstatite.

Sample	Material (grain size)	P [MPa]	T [°C]	Duration (from peak stress)	Water added [wt ppm]	Bulk strain [γ]	Max. shear strain [γ]	Max. strain rate [s^{-1}]
Pure olivine	100% Ol (1-10 μm)	1200	900	42h (5h)	2000	2.5	2.5	$\sim 3 \cdot 10^{-5}$
Two-phase aggregate (fine-grained CPx)	70% Ol (1-10 μm) + 30% CPx (1-10 μm)	1200	900	44h (11h)	2000	4.8	> 5	$\sim 5 \cdot 10^{-5}$
Two-phase aggregate (coarse-grained CPx)	70% Ol (1-10 μm) + 30% CPx (40-125 μm)	1200	900	67h (18h)	1000	4.3	> 10	$\sim 1 \cdot 10^{-4}$
Hot-pressed (fine-grained Cpx)	70% Ol (1-10 μm) + 30% CPx (1-10 μm)	1200	900	24h	1000	-	-	-
Peak stress (coarse-grained CPx)	70% Ol (1-10 μm) + 30% CPx (40-125 μm)	1200	900	48h	1000	1	1	$\sim 3 \cdot 10^{-5}$

Supplementary table 1 | Parameters of deformation experiments in the Griggs-type apparatus. The starting grain sizes and duration of experiments after the peak stress are shown in brackets. P = confining pressure; T = temperature.



Supplementary figure 2 | Olivine Lattice Preferred Orientation (LPO) – For all samples, including the hot-pressed ($\gamma = 0$), “peak stress” ($\gamma = 1$) and pure olivine samples ($\gamma = 2.5$), as well as the two-phase samples with fine- ($\gamma > 5$) and coarse-grained ($\gamma > 10$) CPx, this figure shows LPOs of the three main axes of the olivine lattice ([100], [010] and [001]) with respect the shear plane (horizontal line) and shear direction (white dot). The data are shown in lower-hemisphere pole figures considering all data points in EBSD maps (the maps are shown in figure 6 of the paper). Contours and grey shading are multiples of uniform distribution. N = number of points; J = texture index (Bunge, 1982); M = misorientation index (Skemer et al., 2005).



Supplementary figure 3 | EBSD map of the pure olivine sample – Electron backscatter diffraction (EBSD) analyses were performed on polished thin section (diamond paste of 0.25 μm followed by colloidal silica) with an EDAX Pegasus system using an acceleration voltage of 25 kV and a working distance of 18 mm. The step size is 1 μm. Grain boundaries are defined considering a lattice misorientation angle higher than 10°. Data have been processed with the OIM™ - EDAX software.