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Pure climb creep as the dominant mechanism driving flow in the Earth's lower mantle

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At high pressure prevailing in the lower mantle, lattice friction opposed to dislocation glide becomes very high as reported in recent experimental and theoretical studies. In this presentation we examine the consequences of this high resistance to plastic shear exhibited by wadsleyite, ringwoodite and bridgmanite, on creep mechanisms under mantle conditions. To evaluate the consequences of this effect, we model dislocation creep by dislocation dynamics. The calculation yields to an original dominant creep behaviour for lower mantle silicates where strain is produced by dislocation climb, which is very different from what can be activated under high-stresses under laboratory conditions. This mechanism, named pure climb creep, is grain-size insensitive and produces no crystal-preferred orientation. In comparison to the previous considered diffusion creep mechanism, it is also a more efficient strain-producing mechanism for grain sizes larger than ca. 0.1 mm. The specificities of pure climb creep match well the seismic anisotropy observed of the Earth lower mantle.