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# Two-in-one olivine rheology from numerical deformation experiments (for both lithospheric and asthenospheric mantle) implemented in subduction models

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Numerical modelling of mantle convection and plate tectonics aims at reproducing the observables (e.g. surface plate velocities from paleomagnetic and geodetic data, subducted slab shapes from seismic tomography) while using as input parameters realistic deformation laws for crust and mantle material.

As shown by laboratory experiments, olivine, which is the key upper mantle mineral that endures the lithosphere-asthenosphere transition, can flow over geologic scales with different behaviour depending on temperature and strain rates. Diffusion and dislocation creep are expected to dominate in high-temperature asthenospheric mantle for low and high strain rates, respectively. However, the low-temperature deformation mechanism of olivine, that is expected to dominate in cold subducted slabs, is not yet clearly identified, and geodynamic models have so far used ad-hoc formulations (e.g. the "Peierls" creep) to implement the dependency of viscosity or stress as a function of strain rate.

Here, we used a novel formulation for a rheology law based on numerical dislocation experiments. This flow law has two main advantages : its continuity between high (asthenosphere) and low (lithosphere) temperatures, and its simple form ensuring null stress at very low strain rates. We show that this unique flow law can replace, in numerical simulations of geodynamics, both dislocation creep and a high-pressure low-temperature plasticity with an example of subduction modelling.