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Micro- and nanostructural records of intermediate-depth earthquakes, mineral fragmentation and mass transport in peridotites from Alpine Corsica

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Pseudotachylites and their wall rocks in peridotites from Alpine Corsica present a unique opportunity to study the nucleation of intermediate depth earthquakes and their effect on the further metamorphic and rheological development of a rock.
Previous studies of peridotites form Alpine Corsica described a transition from cataclastic wall rocks to pseudotachylytes and argued that seismic slip occurred through a self-localizing thermal runaway mechanism. Here, we report novel micro- and nanostructures in both pseudotachylytes and wall rocks from the Corsica peridotites obtained by optical, scanning and transmission electron microscopy and electron microprobe analysis. Olivine both within the wall rocks and the pseudotachylyte is characterised by a high dislocation density and a lack of recovery features. Thus, the deformation was dominated by low-temperature plasticity rather than cataclasis and the temperature increase was short-lived, preventing significant annealing or recovery processes. Wall rock fragmentation was furthermore associated with chemical alteration and an introduction of an unidentified Fe, Mg, Ca, Al-silicate and nano-scale Cr-spinel grains between the olivine fragments. Their homogeneous distribution indicates a high mobility in the system suggesting that this alteration was directly connected to the seismic event. The introduction of new phases into the wall rock shows that the increase in fluid flow by an earthquake is not limited to the fault itself, but also affects the surrounding fragmented wall rock.