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Seismic pumping and cataclastic flow - important transport mechanisms during hydration and metasomatism of the oceanic lithosphere

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Transform faults are the locus of earthquakes that extend down to 29 km below the seafloor (Choy and McGarr 2002). These faults are also associated with a mass deficiency (Gregg et al. 2007) possibly caused by extensive serpentinization. The mantle and crustal sections of the Leka ophiolite is characterized by deformation at all scales including faults and shear zones. Ongoing investigations of these structures reveal that olivine is strongly fractured and faulted. Tabular fragments of olivine are rotated relative to each other locally forming bookshelf-like fault pattern. Serpentine and diopside fill the space between the rotated fragments, and the texture suggests that these minerals grew in opening caused by the faults. The growth of secondary minerals indicated high fluid fluxes along these deformation zones. The space created by the faulting is estimated to ca 50 %.The main slip surfaces are decorated by banded serpentine. Each band represents a slip event and more than 10 slip events are recorded across a 1 cm broad fault zone.
The faulting and fragmentation of the olivine, the opening of space between the fragments, combined with mineral growth and repeated faulting provides an efficient seismic (?) pumping system. Rodingites with textures indicating cataclastic flow are developed along some of the faults. The rodingites also show evidence of repeated deformations and growth of minerals such as vesuvianite, grossular and diposide. It is suggested that faulting including seismic pumping and cataclastic flow is an efficient mechanism to hydrate the oceanic lithosphere and cause serpentinization and metasomatism along transform/fracture zones.

Choy and McGarr 2002. Geophys J. Int 150 506-523
Gregg et al. 2007. Nature 448, 183-187