Geophysical Research Abstracts
Vol. 16, EGU2014-6461, 2014
EGU General Assembly 2014

Faulting and Serpentinisation of Peridotites in the Leka Ophiolite,

Kristina G. Dunkel (1), Kerstin Drivdal (1), Håkon Austrheim (1), Torgeir B. Andersen (2), and Bjørn Jamtveit (1)
(1) University of Oslo, Geology/PGP, Norway, (2) University of Oslo, Geology/CEED, Norway

The ocean floor is strongly affected by seismic activity along mid ocean ridges and transform faults, where the upper mantle may undergo extensive alteration and serpentinisation. While the spatial link between faulting and serpentinisation is generally accepted, the causal connection between these two processes is not well understood. The cumulate section of the Leka Ophiolite, north-central Norway, is transected by kilometre long sets of parallel faults and shear zones with a dextral shear. The discrete faults have spacings from centimetres to decimetres and displacements in the same range. They alternate with breccia zones and metre thick shear zones with displacements up to 30 m. The extent of the faulted areas and the consistent dextral displacements indicate a regional deformation process, possibly related to a transform.

The observation of progressive peridotite alteration in the Leka Ophiolite gives new insights into the interplay between serpentinisation and deformation. In the least altered peridotite, propagating fractures produce a texture reminiscent of cleaved olivine. Serpentinisation initiates along the cleavage planes. In more deformed samples, the centres of the discrete faults contain relatively large coherent olivine fragments alternating with trails of small spinel grains parallel to the fault. Most of the spinel is ferrichromite or magnetite, but some contain cores of primary chromite. Towards the margins of the faults, the amount of (fibrous) serpentine and fracturing of olivine increases significantly. The fault margins appear dark in hand specimens, which is due to finely dispersed magnetite grains in olivine and serpentine. The surrounding damage zones contain moderately serpentinised olivine grains exhibiting different deformation indicators such as undulous extinction, deformation lamellae and subgrain boundaries. In the breccia zones, where peridotite clasts are enclosed by deformation zones with the same buildup as the faults, this texture is, to different degrees, overprinted by late-stage antigorite serpentinisation. The faults themselves appear unaffected by this last stage of alteration. This challenges the common assumption that fractures enhance the progress of serpentinisation by providing fluid pathways. During the first stage of serpentinisation, the faults have been preferential reaction sites, as suggested by the abundance of magnetite along these zones and the serpentine along the cleavage planes in olivine. During the later antigorite formation, however, they remained unchanged. We envisage a process similar to the permeability reduction caused by deformation bands in sandstones: The grain size reduction and compaction during shearing apparently resulted in impermeable bands in the peridotites. Nevertheless, there must have been a significant mass flow from the antigorite domains, as they hardly contain any magnetite and brucite, both of which should have formed during serpentinisation. Consequently, the permeability of the deformed peridotite complex as a whole persisted despite the sealing of the fault cores. It remains to explore if the fault barriers played a role in seismic pumping and to couple the tectonic deformation to possible volume changes due to reaction.