Geophysical Research Abstracts
Vol. 20, EGU2018-18408-1, 2018
EGU General Assembly 2018

Self-induced serpentine deformation and its effect on weathering

Ole Ivar Ulven, Håkon Austrheim, and Bjørn Jamtveit
University of Oslo, Physics of Geological Processes, Oslo, Norway (o.i.ulven@fys.uio.no)

Serpentinization is the most significant fluid consuming rock transformation processes in the Earth's crust. Since peridotite is one of the dominating rocks in the oceanic lithosphere, its hydration to form serpentine changes the large scale physical and chemical properties of the crust, increases the amount of subducted water, and might also affect plate tectonics [Jamtveit et al., 2016]. The process has been studied in a number of recent papers, from the interface scale initiation of fractures in olivine during serpentinization [Plümper et al., 2012] to kilometer scale hydration of the oceanic lithosphere [Korenaga, 2006]. However, previous studies of deformation during serpentinization have focused mostly on the deformation of the initial ultramafic rock when subject to hydration, while deformation of the relatively weak early formed serpentine has attracted far less attention.

Serpentine formed during hydration of olivine commonly displays an hourglass texture. Evans [Evans, 2004] described the serpentine polymorph lizardite as forming such textures during growth on primary olivine, and speculated that the force of crystallization might be exerted along the [001] axis of lizardite. In this work, we combine new observations with numerical and analytical methods, and study the grain scale serpentinization mechanism by focusing on the deformation of hourglass textures during volume expansion. Furthermore, we show that the texture formed this way preconditions the rock for subsequent weathering in the critical zone, and potentially affects the carbonation of remnant olivine grains in a partly serpentinized rock. Finally, the work leads us to propose a new mechanism for fracture formation in the ultramafic rock during serpentinization.

References

[1] Evans, B., "The Serpentinite Multisystem Revisited: Chrysotile Is Metastable", *Int. Geol. Rev.* **46**, 2004, pp. 479 – 506.

[2] Jamtveit, B., Austrheim, H., and Putnis, A. "Disequilibrium metamorphism of stressed lithosphere", *Earth-Sci. Rev.* **154**, 2016, pp. 1 – 13.

[3] Korenaga, J., "Thermal cracking an the deep hydration of oceanic lithosphere: A key to the generation of plate tectonics?", *J. Geophys. Res.* **112**, 2006, B05408.

[4] Plümper, O., Røyne, A., Magraso, A., and Jamtveit, B., The interface-scale mechanism of reaction-induced fracturing during upper mantle serpentinization, *Geology* **40**, 2012, pp. 1103 – 1106.