Syntectonic serpentinite dehydration within subduction zones

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At subduction zones seawater-altered oceanic lithosphere is returned to the Earth's mantle, where increasing temperatures and pressures result in the progressive destabilization of hydrous minerals releasing aqueous fluids. This cycling of volatiles is one of the most distinctive features of subduction zones and has fundamental consequences for Earth's geodynamics as well as chemical cycles. Fluids released from the subducting slab trigger sub-arc mantle melting leading to explosive volcanism and induce petrophysical changes during dehydration that are thought to be a source of intermediate-depth seismicity. Previously, we have investigated fluid escape mechanisms during serpentinite dehydration in a largely undeformed part of the Erro-Tobbio unit, Italy [1]. This unit has been subducted to peak metamorphic conditions of 2.0–2.5 GPa and 550–600 ºC, resulting in antigorite+brucite breakdown to form olivine+H_2O. Here, we focus on those domains that have undergone *syntectonic* dehydration to determine (i) the impact of deformation on fluid escape and (ii) the overall rheological behaviour of a dehydrating serpentinite system. To approach these issues we combine hyperspectral Raman imaging (HRI) with multi-scale electron microscopy encompassing backscattered electron mapping, electron backscatter diffraction, focused ion beam scanning electron microscopy and transmission electron microscopy. Crystal orientation mapping revealed that the antigorite is characterised by a crystallographic preferred orientation (CPO), whereas the metamorphic olivine lacks CPO. HRI of the deformation bands shows that nearly all olivine grains are surrounded by a prograde, hydrous phyllosilicate phase that is different to the original antigorite. In addition, these shear bands do not exhibit signs of instantaneous dehydration embrittlement. Based on these first results we discuss the rheology of a dehydrating serpentinite system.

References: [1] Plümper, John, Podladchikov, Vrijmoed & Scambelluri (2017), *Nature Geoscience* 10(2), 150-156.