



Mechanics and seismic signature of brittle deformation of serpentinites

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It is well recognised that serpentinites play a major role in subduction zone processes, such as tectonic evolution of the oceanic lithosphere, earthquake nucleation, or recycling of water in the upper mantle. However, it is not yet clearly known how and by which micromechanical process serpentinites deform, and what is their signature on seismic properties.

Deformation experiments were conducted on 90%-rich antigorite polycrystalline serpentinite in the brittle field, under varying conditions of confining pressure, with simultaneous measurements of axial and radial strains, and P and S-wave velocities at various directions with respect to the applied stress. Failure, controlled-failure, and cyclic-loading tests were performed to investigate the strength, dissipation of mechanical energy, seismic signature and resulting microstructures of a suite of antigorite specimens.

The brittle deformation of antigorite is mostly non-dilatant and accommodated by shear microcracks localised over a very narrow zone near the failure plane – as confirmed by microstructural observations. Antigorite serpentinites display a failure strength as high as for crystalline rocks, and a yield point occurring close to failure. Another untypical feature observed during deformation of the antigorite specimens is the spectacular absence of any wave velocity evolution, and any stress-induced anisotropy, during axial compression. Such results may have strong implications for the understanding of subduction zone dynamics, which remain to be complemented by mechanical tests conducted in the ductile regime.