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Elastic softening of lizardite under pressure

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Lizardite belongs to serpentine group, and is a common rock forming hydrous magnesium phyllosilicate. Lizardite is expected to exist at very cold regions (below 400C) in subducting slab and suggested to be a carrier of water into the Earth's interior.
Crystal structure of Lizardite consists from three layers; the layers of SiO4 hexagonal rings, the MgO6 octahedral layers, and the hydrogen bond layers. We investigated the crystal structure and the elasticity of lizardite under pressure using first principles techniques. At 10 GPa, very sudden elastic softening was observed, associated with a slight change in the compressibility of c axis. This behavior is related to a collapse of SiO4 hexagonal rings to the trigonal ones. This elastic softening causes reductions of seismic velocities VP and Vf by about 16% and 24%, respectively. These velocities, in turn, suddenly increase by further compression. Shear velocity VS, on the other hand, gradually decreases with pressure and then abruptly increases about 14% at 10 GPa. Since these valley-like changes in velocities complete within very small pressure intervals (2-3 GPa), previous investigation might fail to detect these elastic anomalies (Mookherjee and Stixrude 2009). X-ray diffraction studies previously reported a change in compressibility of lizardite at about 6-8 GPa (Hilairet et al. 2006; Nestola et al. 2009) which is consistent with the present results. Since other hydrous phyllosilicates such as clay minerals, mica and chlorite have similar crystal structures to lizardite, these anomalous softening is also expected in these minerals under pressure.

Mookherjee and Stixrude (2009) EPSL,doi:10.1016/j.epsl.2008.12.018.
Hilairet et al. (2006) PCM, doi:10.1007/s00269-006-0111-0.
Nestola et al. (2009) Contrib Mineral Petrol, doi:10.1007/s00410-009-0463-9.