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High-pressure Brillouin and Raman spectroscopy of a natural antigorite single-crystal

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The high-pressure polymorph of serpentine, Antigorite, is a candidate mineral to transport “water” into subduction zones. Its expected dehydration under elevated pressure-temperature conditions markedly affects physico-chemical properties and processes in these regions and is considered to trigger subduction zone seismicity. In order to map hydration in subduction zone environments, laboratory data on the (anisotropic) sound wave velocities of serpentine minerals are needed. Here, we present high-pressure acoustic wave velocities, measured within the a-c-plane of a natural antigorite single-crystal by Brillouin scattering. Preparation of the desired sample for Brillouin Spectroscopy was possible by using the focused ion beam technique. The chosen crystallographic plane is representative of the expected preferred orientation of antigorite crystals in a subduction zone environment and, therefore, our results put direct constraints on the expected seismic anisotropy emerging from a crystallographic preferred orientation (CPO) of antigorite in these regions. In addition, we performed direction-dependent high-pressure Raman Spectroscopy of the same single-crystal. We find anomalies in the pressure dependence of both acoustic wave velocities and measured Raman shifts at a pressure of around 7 GPa. This observation is consistent with previous Raman and x-ray diffraction studies and likely related to a stress-induced proton re-orientation in the crystal structure.