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The serpentinized plate interface: detection and controls on subduction zone deformation

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Antigorite serpentine is the major component of metamorphic serpentinites in subduction zone context. Its presence and deformability likely control the downdip extent of the seismogenic zone, as well as exhumation processes. Large deformation of serpentinites may induce a strong anisotropy of various properties in serpentine bearing-rocks. For example, seismic anisotropy is potentially extreme in serpentinites and may allow their seismic detection as well as the determination of the deformation pattern at the plate interface and in the mantle wedge. I argue here that hydration of the mantle wedge down to 100 km exerts a significant control on the tectonic evolution of subduction zones. Links between antigorite deformation, seismic properties, and seismicity are suggested from experimental deformation and elasticity measurements. Rheological measurements are consistent with "fast creep" events at timescales down to those associated with slow slip events and silent earthquakes. The impossibility of building stress in very serpentinized areas could also explain seismicity gaps, and high exhumation speed in a serpentinized mantle wedge. Elastic measurements on single-crystal antigorite confirm the strong anisotropy of serpentine and of deformed serpentinites with strong lattice-preferred orientations. Low seismic velocities remain the best signature of serpentinization. Their observation is limited to shallow (<60 km depth) mantle wedge of hot subduction, and in some cases to anisotropic thin layers at the top of subducting slabs. Thin sheared serpentine layers may remain elusive for seismic tomography while capable of absorbing most of the deformation at the plate interface.