Intrinsic seismic attenuation: new approaches and new results

Abstract:

Constraining the origin of intrinsic seismic attenuation in the Earth, its amplitude and its frequency dependence is crucial for: 1. correcting for velocity dispersion due to attenuation; 2. constructing attenuation and velocity models of the interior using datasets with different frequency contents; and, 3. interpreting lateral variations of velocity and attenuation in terms of temperature and composition. Despite their importance, efforts at determining the characteristics of seismic attenuation from surface wave and free oscillation data have been thwarted by the strong tradeoffs between the depth- and frequency dependence of attenuation. Also most of the recent seismic studies have only concentrated on the shear attenuation assuming that the compressional attenuation in the mantle is negligible. In the first part of the talk, we develop and validate a new method that eliminates this tradeoff, allowing a direct estimation of effective frequency dependence of attenuation without having to construct a new depthdependent model of attenuation. Using normal mode and surface wave attenuation measurements between 80 and 3000 s, develop a new model of the absorption band. In the second part, we introduce a selfconsistent model for the shear and compressional attenuation that may be arising within regions of multi-phase coexistence. We derive a simple analytical model of a two-phase loop to show that the phase change should affect both the bulk and the shear attenuation and in rather similar proportion. We show that attenuation occurs over two different frequency ranges.