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Effect of seismic reference model on the physical interpretation of seismic structure

Saskia Goes (1), Fabio Cammarano (2)

(1) Dept. Earth Science and Engineering, Imperial College London, U.K. (2)Berkeley Seismological Laboratory, University of California Berkeley, USA (s.goes@imperial.ac.uk)

Well-constrained reference models are important for physical interpretation of seismic velocity models, especially in the upper mantle. Due to anelasticity, seismic velocities in the upper part of the mantle depend non-linearly on temperature. Therefore, a thermal interpretation requires absolute velocities. Without a constrained reference, uncertainties in the translation of velocity anomalies into temperature anomalies can be up to a factor 2, and it is unclear whether they are anomalies to local, regional or global structure. It is usually assumed that global seismic reference models represent an adiabatic, pyrolitic mantle with a potential temperature compatible with that of MORB generation. But thermal interpretation of seismic 1-D models, as well as a comparison of synthetic velocities for adiabatic pyrolite with seismic data identify several problems: (1) the sublithospheric gradient of most commonly used reference models translates into a negative temperature-depth gradient, (2) transition zone velocities yield a jump to very high temperatures below 410 km and non-adiabatic gradients. It is unclear whether these features are really required by the seismic data. Basing the parametrization of seismic reference models on physically plausible reference structures might amend these problems. Including uncertainty estimates in 1-D reference models and carrying these through inversions for velocity structure will further facilitate physical interpretation.