3-D elastic and anelastic structure of the lowermost mantle beneath the western Pacific from finite-frequency tomography

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We introduce a finite-frequency tomography method as to simultaneously obtain 3-D shear velocity (V_S) and seismic attenuation (described as quality factor Q) structures using travel time and amplitude data. We apply this method to the mapping of V_S and Q structure in the lowermost mantle beneath the western Pacific, at an edge of the Pacific large low shear velocity province (LLSVP). We used S and ScS waves of seismograms for 31 earthquakes which occurred around the region of Tonga and Fiji. Our dataset consists of the transverse components of 1341 traces obtained from the F-net Japanese seismic station network. The waveform data is rendered to a bandpass filter of a range of 12.5–200 s, corresponding to 0.005–0.08 Hz. Both shear velocity and attenuation (Q) have lower values than PREM at the center of the bottom depth range. This feature is robust per a variety of inversions in different inversion configurations. Based upon the obtained shear velocity and attenuation (Q), we also predict possible temperature anomalies in this region. Discrepancy between the temperature anomalies predicted by the two data sets suggests that shear velocity anomalies result not only from temperature anomalies but chemical anomalis. Assuming that Q-anomalies are a good proxy for temperature, and that compositional anomalies primarily consist of an excess in iron oxide and depletion, we propose a possible thermal and compositional structure for this region. Revisions to fundamental analytical software have been effected such that more varieties of waveform analysis may be performed, utilizing progressively larger datasets. The design of packages for the computation of forward propagation has been refined to greater efficiency. The purpose, for the present, is to enable the Montecarlo inversion of waveforms. We will present the current version of the software, and demonstrate preliminary attempts to perform the Montecarlo inversion.

Keywords: attenuation, lowermost mantle, waveform inversion

