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Seismic Attenuation Tomography of the Australian Continent

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The strategic position of the Australian continent in the middle of the seismicity belt which extends from Indonesia, through New Guinea to Fiji, Tonga and New Zealand with the extensive deployment of portable broadband seismic stations across the Australian Continent and Tasmania since 1993 offers robust seismological data with a dense coverage at distances from 5˚ to 45˚. P and S wave seismic traveltimes from nearly 4050 three-component seismic dataset from the record have been hand picked. The wave ratio method is then applied to estimate the spectral ratio between shear (SH and SV) and compressional waves. Seismic spectra are estimated using the Multitaper method with 512 points in window range of 30s to 45s and frequency range of 0.25Hz to 1.00Hz.

Three-dimensional P and S wave speed tomography is conducted by inverting a kernel matrix obtained from a quasi three dimensional ray tracing which respect to P and S wave seismic traveltime residuals from the ak135 model. The study area from latitude 22˚ N to 65S˚ and longitude 78˚ to 189˚ and 0-1240km depth is discretized into 11100 cells with a cell size 3˚x3˚ and depth range of 35 to 200km. Both P and S-wave speed information from the seismic wave speed tomography are then utilized as data input for the three-dimensional seismic attenuation tomography. In this inversion, it is assumed that $Q_P = 2.3Q_S$. The seismic attenuation anisotropy in term of the ratio between seismic attenuation derived from SV and SH component is also presented.

The major feature that is revealed from the both seismic wave and seismic attenuation studies is a strong contrast in deep structure between central Australia and the eastern seaboard. The Archaean and the Proterozoic rocks in the west and in the middle of the continent are associated with a high seismic wave speed anomaly and low seismic attenuation and the Phanerozoic rocks and the presence of recent volcanism and region of high heat flow in the east are associated with low seismic wave speed anomaly and high seismic attenuation. The representation of seismic attenuation anisotropy suggests that in the region where seismic coverage is good, transverse component (SH) wave is less attenuated than radial component (SV).

Keywords: tomography, wave speed, attenuation, anisotropy