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Spatial distribution of random inhomogeneities and intrinsic attenuation in the crust and uppermost mantle

Tsutomu Takahashi[1*]

[1]JAMSTEC

High frequency seismic waves (>1Hz) that are impulsively radiated from a point source are collapsed and broadened as travel distance increases. This broadening process can be described by the multiple forward scattering due to random velocity inhomogeneities and intrinsic attenuation. Recent progresses of the theoretical studies on the wave propagation in random media clarified mutual relations between the seismic wave envelopes and statistical properties of random velocity inhomogeneities [e.g., Saito et al. 2002 JGR]. On the basis of these studies, inversion approaches have been proposed to estimate the 3D distribution of random inhomogeneities and intrinsic attenuation [Takahashi et al. 2009, GJI; Takahashi et al. 2010, JPGU SCG004-01]. For example, inversion analysis in the northeastern Japan imaged the strongly inhomogeneous regions at small spatial wavelength range (~ a few hundred meters) beneath the Quaternary volcanoes and at the high-seismicity region [Takahashi et al. 2009, GJI]. Random inhomogeneities beneath the Quaternary volcanoes are characterized by weak spectral gradient. Meanwhile, those in the high-seismicity region has steep spectral gradient. Intrinsic attenuation structure in the northeastern Japan shows strong attenuation beneath the Quaternary volcanoes (1/Q~1/300 at 4-8Hz) and high-Vp/Vs region in the fore-arc side of the volcanic front (1/Q~1/500 at 4-8Hz). Dimension reduction for random inhomogeneities, intrinsic attenuation and seismic velocity [Matsubara et al. 2008] shows components that are related to volcano distribution and seismic activity. This reduction result implies that random inhomogeneities and attenuation are important to characterize medium properties in the crust and uppermost mantle.

Keywords: random inhomogeneities, intrinsic attenuation, dimension reduction