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Three dimensional structure of random velocity inhomogeneities in and around the Hyuga-nada region

Tsutomu Takahashi[1*], Koichiro Obana[1], Yojiro Yamamoto[1], Ayako Nakanishi[1], Shuichi Kodaira[1], Yoshiyuki Kaneda[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 multiple forward scattering in randomly inhomogeneous media. Recent studies on seismic wave scattering and attenuation pointed out the importance of random inhomogeneities and intrinsic attenuation to characterize medium properties [e.g., Takahashi et al. 2009; Carcole & Sato, 2010]. From Dec. 2008 to Jan. 2009, Japan Agency for Marine-Earth Science and Technology (JAMSTEC) deployed 160 ocean bottom seismographs (OBSs) at Hyuga-nada region as a part of "Research concerning Interaction Between the Tokai, Tonankai and Nankai Earthquakes" funded by Ministry of Education, Culture, Sports, Science and Technology, Japan. This study estimates the spatial distribution of the power spectral density function (PSDF) of random inhomogeneities, and examines the relations with crustal velocity structure and seismic activity.

Random inhomogeneities are estimated by the inversion analysis of the peak delay time of S-wave of small earthquakes, where the peak delay time is defined as the time lag from the onset to the maximal amplitude arrival. We assumed the von Karman type functional form for the PSDF. Peak delay times are measured from root mean squared envelopes at 4-8Hz, 8-16Hz and 16-32Hz. Inversion result can be summarized as follows. Random inhomogeneities beneath the Beppu-Shimabara rift zone are characterized by strong inhomogeneities at small spatial scale (˜ a few hundreds meter) and weak spectral gradient. Those in the Hyuga-nada region are characterized by the weak inhomogeneities at small spatial wavelength and steep spectral gradient. Note that inhomogeneities at large wavelength (˜ a few kilometers) is larger than its surrounding area, which is consistent with the broadened wave trains at 4-8Hz observed by OBSs. Random inhomogeneities in the Hyuga-nada region are similar with those in the frontal arc high in northern Izu-Bonin arc, which is thought to be a remnant arc that is presently inactive [Takahashi et al. JGR in press]. This coincidence implies the existence of subducted Kyushu-Palau ridge in this anomaly of random inhomogeneities, that is also suggested by the seismic refraction survey in this region [Nakanishi et al. 2010 AGU Fall Mtg.]. Source rupture areas of large earthquakes (M>6) in Hyuga-nada region tend to locate around this anomaly of inhomogeneities. We may say that this anomalously inhomogeneous region is a structural factor affecting the seismic activity in Hyuga-nada region.

Keywords: random inhomogeneities, Nankai trough, Hyuga-nada