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Inhomogeneous Structure of the Crust Inferred from Coda S Envelopes

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We have estimated inhomogeneous structure of the crust in and around the focal area of 2000 Western Tottori earthquake from coda S envelopes. Waveform data used are those observed at 4 seismic arrays deployed by Tohoku univ., Ehime univ., and Yamagata univ. in the focal area. A local increase of coda amplitudes was observed at a lapse time of about 15 sec from the origin time for many seismogram envelopes. Such an anomalous feature can't be detected for seismogram envelopes of aftershocks that occurred in the southern part of the aftershock area observed at array A02 which is located in the northern part of the aftershock area. This difference in the shape of the seismogram envelope can be explained by the spatial variation of scattering coefficient. Obara et al. (2001) pointed out that anomalous seismogram envelopes observed at their stations can be explained by a high scattering coefficient zone located in the lower crust north of the mainshock hypocenter. We used seismogram envelopes of many aftershocks observed at the 4 array to estimate spatial distribution of scattering coefficient. We calculated synthetic seismogram envelopes based on single scattering theory. Energy density of coda waves is represented by a summation of scattered energy contributions from many small cubic blocks, which compose the crust and upper mantle of the target area, according to Obara (1997). In our algorism we evaluated both effects of scattering attenuation and intrinsic absorption along each path of scattered waves. Therefore it is expected that the effect of the wave energy attenuation by passing through blocks with high scattering coefficients, is appropriately evaluated. We assumed Qi^-1 = 0.0017 for seismic waves with 5-10 Hz in all blocks referring to Hoshiba (1993). This is because it is difficult to independently estimate parameters of scattering attenuation and intrinsic absorption. Best fit model to explain the observed seismogram envelopes was estimated trial-and-error. In this analysis, we used observed seismogram envelopes with lapse times from 1.5 times of direct S-wave travel time to 25 seconds from the origin time. The obtained result shows that the high scattering coefficient zone detected by the previous study beneath the mainshock hypocenter is located in the lower crust, while the high scattering coefficient zone spreads not only in the lower crust but also in the upper crust beneath the northern part of the aftershock area. This high scattering coefficient zone in the upper crust in the northern part of the aftershock area may be related to the complicated distribution of aftershocks in that area. Present study shows that the envelope modeling is one of effective methods to estimate inhomogeneous structure of the crust.