A Study of Depth Dependence of the Apparent Q in Tohoku Region From Accelerogram Data

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To study possible dependence of Q with depth we used method of Iwata and Irikura, 1988, for the separation of source, site and path effects with some modifications. We allow the Q-value to be variable with depth and subregion in a block model of the medium with constant Q in each block. Path lengths within blocks are calculated using ray approximation. This method was applied to a set of KNET data in the Tohoku area of Japan. Results of Q structure inversion show that Q has a minor variation with depth in the range 0-65km, and decreases at the depth 65-100km; and Q has evident frequency dependence in all depths.

The Q-value is important in the modeling of strong ground motion parameters in seismic engineering applications. In this work we studied possible dependence of Q with depth. Previous studies of the dependence of Q with depth show two opposite tendencies. Analysis of scattered and coda waves show that Q can increase with depth due to the decrease of scattering properties (and inelastic loses respectively) in the upper mantle. Results of the estimation of Q structure in the crust and upper mantle at low frequencies show that Q should decrease with depth (e.g. PREM model) due to existence of the low velocity zone at depth 80-220km.

In this study we used method of Iwata and Irikura, 1988, for the separation of source, site and path effects with some modifications. We allow the Q-value to be variable with depth and subregion in a block model of the medium with constant Q in each block. Path lengths within blocks are calculated using ray approximation. As different from previously applied methods of attenuation tomography, this one considers the amplitude Fourier spectrum separately at each frequency, thus enabling the study of the frequency dependence of Q. Taking into account site conditions allows us to include data at stations in a wider range of ground conditions. This method was applied to a set of KNET data in the Tohoku area of Japan. Possibly due to focusing effects, our estimates of 1/Q-value in some blocks at particular frequencies have both large shift to zero and large errors. We assumed these estimations unreliable and excluded them. The remaining points were fitted to estimate a power-law model Q(f) = Qo*f^n separately for each block.

Results of Q structure inversion show that Q has a minor variation with depth in the range 0-65km, and decreases at the depth 65-100km; and Q has evident frequency dependence in all depths. These results are compared with the results of similar work by Nakamura and Uetake, 2000, for the same region.