Effects of inhomogeneity of sedimentary layers on attenuation characteristics

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It is well known that Q values, which are evaluated by spectral ratio inversion, depend on frequency. It is generally pointed out that scattering of elastic and acoustic waves in inhomogeneous sedimentary layers causes this feature. In order to evaluate the scattering attenuation Q in inhomogeneous sedimentary layers, we conducted numerical simulation of inhomogeneous media by using hybrid pseudo-spectral method / finite difference method. The inhomogeneity is characterized by autocorrelation function which is derived from P-S logging data using suspension method at Kashima site where is installed 9 seismometers from surface to GL-502m. Using inversion analysis of the P-S logging data, we can estimate only vertical correlation length a. Therefore we assume double exponential function as an autocorrelation function and consider several horizontal correlation lengths b. Vertical correlation length a is estimated 0.8m at Kashima site and horizontal correlation lengths b is considered for 2m, 5m, 10m. From numerical simulation, we observe larger scattering attenuation for anisotropic media than isotropic media of a=b with frequency range from 6Hz to 14Hz.

Scattering attenuation Q in Kashima site is also evaluated by spectral ratio inversion using genetic algorithm and is compared with scattering attenuation Q observed in the numerical simulation for double exponential media assuming Kashima site. As a result, scattering attenuation Q of numerical simulation is disagreement with that of spectral ratio inversion. According to single scattering theory, it is predicted that Q of numerical simulation with larger vertical correlation length is consistent with Q of spectral ratio inversion. These results suggest that scattering attenuation Q in inhomogeneous sedimentary layers may be strongly affected by larger inhomegeneity (e.g. discontinuous layer boundary) rather than by small velocity fluctuation.