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Anelastic Mantle Structure beneath the Northern Philippine Sea

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Anelasticity of the mantle provides important constraints on its dynamics as well as elasticity. However, studies of lateral variation in attenuation are quite a few, especially at short-period because of various technical difficulties. It is important to determine attenuation structure in short period not only for high-resolution image but also for frequency dependence of Q.

In this study, we determine the body wave attenuation structure of the mantle beneath the northern part of the Philippine Sea. Elastic tomography studies [e.g. van der Hilst et al., 1991; Fukao et al., 1992] show a stagnant Pacific lithosphere just above the 660 km discontinuity in this region. This stagnation was caused by the trench retreat due to the back arc spreading during the past 30 - 17 Ma [Seno et al., 1993; van der Hilst, 1995; Shito and Shibutani, 2001]. Anelastic properties of the mantle and the lithosphere may play important roles in the interaction of the slab and the mantle of this area.

The S-P phase pair method uses the spectral ratio of S and P waves from the same earthquake at a given station. We use velocity waveform recorded at 43 broad-band stations of the J-array and the FREESIA networks in Japan. All events are located within from 1 to 15 degrees in epicentral distance. The S and P waves are taken from the transverse and vertical components, respectively. The time domain signals are windowed from 5 second before to 15 second after the manually picked onsets, and then they are Fourier-transformed to amplitude spectra. The differential high frequency spectral decay dt* is estimated from the trend of the regression line of the spectral ratio of S and P waves assuming a constant Qp/Qs over the frequency band of 0.2 to 0.7 Hz. Tomographic inversion is performed to determine the 2-D attenuation structure using the of dt* data along 800 raypaths from 30 earthquakes in the Pacific and the Philippine Sea slabs. We assume that the structure is uniform in the direction parallel to the strike of the Pacific slab (nearly equal to the north-south direction).

The resultant preliminary Q model shows the local variations of attenuation in the subduction zone. The slab is imaged as a high Qp area where Qp values are greater than 1000, while low Qp area where Qp values are smaller than 150 are found in the mantle wedge.