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Attenuation Structure beneath Southwest Japan

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In recent years, local earthquake tomography has become a routine tool for determining the three dimensional P and S wave velocity structure. These two physical parameters are often not sufficient to gain a good geological interpretation and also a good understanding of the physical processes involved. Therefore, the determination of the 3-D distribution of other physical parameters is desirable. One such a physical parameter is seismic attenuation (Q) which can be estimated utilizing the amplitude-frequency information contained in seismic waveforms. Compared to velocity structure studies, only a few number of attenuation structure studies have been carried out in Japan. Examples are those of Umino and Hasegawa (1984), Hashida (1989), Sekiguchi (1991), Tsumura et al. (1996 and 2000). Most of these studies, however, have been concentrating on the Q structure of the eastern part of Japan. Very few Q structure studies have been carried out in southwest Japan and in only localized areas; e.g. Rietbrock (2001). Thus, only a little is known about the Q structure of that region. For this reason, in this study, we investigate the 3-D P wave attenuation structure of the crust and upper mantle in southwest Japan using P-wave spectra of microearthquakes recorded by the High Sensitivity Seismographic Network (Hi-net). Spectra of a 2-second, cosine-tapered time window after the first arrival were calculated. In total, about 100 events comprising approximately 4000, high quality waveforms have been analyzed. These spectra were then inverted using a joint inversion for source parameters, site response and Q values (Tsumura et al., 2000). Waveforms recorded at northern Chugoku district near the Japan Sea coast were found depleted from higher frequencies compared to those recorded near southern Kyushu, Shikoku and Kii Peninsula. This reflects the heterogeneous attenuation structure between the mantle wedge part and the subducting Philippine Sea plate. Spatial distribution of low-Q zones found in this study is nearly consistent with the low velocity zones as revealed from travel time tomography. These results indicate the close relationship between the Q structure and the heterogeneous distribution of temperature in the mantle wedge.

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