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Three dimentional seismic attenuation structure of upper crust in the north area of central Japan.

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In Niigata-Kobe Tectonic Zone, where strain accumulation has been reported from GPS data [Sagiya et al. (2000)], joint seismic observations have been conducted by Japanese university group, the research institutes and JMA since 2004 [Japanese University Group of the Joint Seismic Observations at NKTZ (2005)].

Since Q value, which represents the attenuation of seismic waves, depends on the physical properties of the medium, Q structure is a good clue to presume the state of underground in detail. We applied a joint inversion method [Tsumura et al,(2000)] to P wave spectra of microearthquakes and estimated seismic source parameters and Q structure of shallow part of the crust simultaneously.

The data used for the inversion were observed in the period from November, 2005 to December, 2007. We used 119 earthquakes obtained in 168 seismic stations for the analysis. These events occurred in the depth shallower than 15 km, and their magnitudes are 1.5 or more. For inversion, we read first arrivals of P and S wave, and polarity of P waves. When deciding hypocenters, we used the velocity structure determined by Kato et al.(2006). The velocity spectrum of 0.8-second waveform after P-wave arrival was calculated by FFT. The number of spectra is 4298. We assumed that these source spectra have w2 shape. Q structure and source parameters are determined to minimize the total sum of the square of the logarithmic residuals between theoretical spectra and the observed spectra.

Q values become lower than the surroundings at regions where hypocenters concentrate. (e.g. beneath the Hida Mountains or at the depth deeper than 5km of the southern part of Mt. Hakusan.). Aseismic regions on the southeast of the Atotsugawa fault and on the north of the Ushikubi fault have extremely high Q.

In the western part of Atotsugawa fault, high Q values are estimated for the depth from 1.5km to 5km, while those of the depth deeper than 5km indicate low.

In the region where creep like movements were reported (hereafter we call it creep zone), Q values become high as the same as those of the western part of the fault. Furthermore the western end of this creep zone has low Q from the surface to the depth of about 10km. This low Q zone seems to be a boundary of seismic zone and aseismic zone along the Atotsugawa fault.

Comparing our results with the velocity structure determined by Kato et al.(2007), we found that high Q region approximately corresponds to high Vp region in the western part of the Atotsugawa fault. However such tendency is not clearly seen in the creep zone and in the eastern part of the fault.

From the cross section across the Atotsugawa fault, we found that Q structure shows quit different pattern in the western part and in the central part where the creep zone was involved. In the creep zone, slightly low Q distributes in the bounded region between the Atotsugawa and the Ushikubi faults and the outer parts of these faults have high Q. On the contrary, in the western area, the region just beneath the surface trace of the Atotsugawa fault doesn”t show low Q.

Such inhomogeneous Q structure might affect the non-uniform distribution of hypocenters in and around the Atotsugawa fault.