Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

SSS34-P06 Room:Convention Hall Time:May 21 13:45-15:15

Estimation of quality factor of auto correlation function obtained by seismic interferometry around the Noubi fault zone

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Based on the seismic interferometry, it is expected that the autocorrelation function of ambient noises at a single station gives the signal equivalent to the scattered seismic waves whose hypocenter and the station are at an identical location (Claerbout,1968). Sens-Shoenfelder and Wegler(2006) reported the quality factor of auto correlation function (QACF) obtained by seismic interferometry is coincident with Qc reported by Jin and Aki(2005). However, there are some reports that show different results from those of Sens-Shoenfelder and Wegler (2006)(e.g.Mouri et al.,2010; Tsuji et al., Seismological Society of Japan 2011,Fall Meeting).In this study, we examine the relationship between seismicity and the quality factor of both QACF and QC using a dense seismic network data.

For QC analysis, we use event data recorded at stations around the Noubi fault zone. The period is from 2009/06 to 2011/06. We use 5 frequency bands, 1-2, 2-4, 4-8, 8-16 and 16-32Hz to estimate the quality factor. We use the model of Aki and Chouet(1975) represented by the following formula that is able to apply to both surface wave (n = 1/2) and body wave (n = 1),

Ac (f|t)=A/t^n * exp((-pai*ft)/(Q_C (f))) ,

where , AC(f|t) is the RMS amplitude of the band-pass filterd auto correlation function, f is the central frequency, t is the lapse time.

For QACF analysis, we use continuous seismic waveform data recorded at stations around the Noubi fault zone. The period is from 20010/02 to 2010/05. We use the same frequency bands and the model with n = 1 as the QC analysis.

We, here, estimate the n value assuming QACF = QC. As a result, the average n values are 0.87+-0.47(1-2Hz),0.50+-0.38(2-4Hz), 0.57+-0.44(4-8Hz), 0.38+-0.36(8-16Hz), 0.44+-0.38(16-32Hz), respectively. If QACF is a parameter that indicate the same heterogeneity as QC, n value should be 1.0. Therefore QACF is considered to reflect different heterogeneity from QC. Moreover, the body wave assumption (n = 1) provides no positive values of QACF, showing that QACF obtained by seismic interferometry may be the quality factor of surface wave.

The obtained QC is roughly the same as QC reported by Jin and Aki(2005).On the other hand, the value of QACF is roughly a half value of QC. We examine the relationship between both the quality factors and the number of the earthquakes occurred in small areas that are separated by 6min*6min in the analyzed area. For the source depth of 4.0-9.0km, QACF shows a slightly negative correlation(R=-0.22) and QC a no correlation (R=0.06) with the number of the earthquakes. On the other hand, For the source depth of 9-14km, QACF shows no correlation (R=0.09) and QC a negative correlation(R=-0.56) with the number of the earthquakes. This supports that QACF reflects different crustal heterogeneity from Qc.