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High attenuation of S-wave in the focal region of the 1997 northwestern Kagoshima earthquakes

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We estimated quality factor of S-waves (Q^-1) inside and outside the focal region of the 1997 northwestern Kagoshima earthquakes, using the aftershock records by velocity-type strong motion seismometer located on the granite site. We found that S-wave attenuation in the focal region is several times as large as that outside. On the other hand, Q^-1 in the focal region is an half of the values which is as well known as in the fault zones. Therefore S-wave attenuation in the focal region is not so strong as in the fault zone. This result suggests that the focal region cannot be simply separated into two segments, those are fault zone and crust enclosing the zone, but the transition zone exists between these segments.

In 1997, two moderate earthquakes occurred in the northwestern part of Kagoshima prefecture (M_JMA6.5 on Mar. 26 and M_JMA6.3 on May 13). Kyushu University installed velocity-type broad-band strong motion seismometer at sibi, which is one of the permanent stations operated by Kagoshima University, and have observed aftershocks since Mar. 28 just after the mainshock. Station sibi is located on the granite site of Mt. Sibi and is also just on the focal region. We investigated the quality factor of S-waves, Q^-1 which characterizes S-wave attenuation, in the focal region, using the aftershock records collected just after the mainshock to March in 1998.

To take frequency dependence of Q^-1 for S-waves into account, we measured Q^-1 at ten frequency bands centered at 1.5, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 12.0 and 24.0 Hz independently, using the coda normalization method developed by Aki (1980). Before applying this method, we checked the effect of radiation pattern on the spectrum of the observed S-waves. We found that S-wave at lower frequencies (1.5 and 3.0 Hz) is affected by the radiation pattern. On the other hand, that at higher frequencies does not show the radiation pattern. We then applied a correction of radiation pattern only at 1.5 and 3.0 Hz bands in the measurement of Q^-1. The Q^-1 values estimated from the NS-component of seismograms show the following frequency dependence, Q^-1(f)=1.03*10^(-1) f^(-0.96). The estimated Q^-1 for each frequency band is several times as large as the standard values in the normal crust (not focal region).

We also estimated Q^-1 outside the focal region by using the aftershock records collected at ITK which is the nearest station to the focal region among the permanent stations operated by Kyushu University. ITK is located outside the focal region. In the measurement of Q^-1, anelastic attenuation effect of S-wave due to passing through the focal region was corrected by Q^-1 inside the focal region shown above. We found that the frequency dependence of Q^-1 outside the focal region is Q^-1(f)=1.03*10^(-2) f^(-0.59). The estimated Q^-1 is almost equal to result of Kato (1999), which shows the averaged value in the crust at Western Kyushu. The values are also consistent with the standard values in the crust measured in the much of other studies.

We notice S-wave attenuation in the focal region is several times as large as that outside. On the other hand, Q^-1 in the focal region is an half of the values which is as well known as in the fault zones (e.g., Li et al., 1998). Therefore S-wave attenuation in the focal region is not so strong as in the fault zone. This result suggests that the focal region cannot be simply separated into two segments, those are fault zone and crust enclosing the zone, but the transition zone exists between these segments.