SSS33-P18 Room:Convention Hall Time:May 19 18:15-19:30

Relation between stress drops and depths of strong motion generation areas based on previous broadband source models

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Miyake et al.(1999) showed that broadband strong motion records in the near fault regions for the 1997 Kagoshima-ken Hokusei-bu earthquake were simulated using strong motion generation areas (SMGAs) by the empirical Green's function method. After their pioneering work, the broadband source models composed of strong motion generation areas were estimated for many earthquakes by many researchers by the empirical Green's function method. On the other hand, Asano and Iwata (2011) studied on the relations between stress drops and depths of asperities for crustal earthquakes. Here asperities (Somerville et al., 1999) were estimated from long-period heterogeneous source models by waveform inversion method using strong motion records in the period range longer than about 1s. They derived the relation that the stress drop is large, so that asperity is deep. In this study we study on relations between stress drops and depths of strong motion generation areas based on previous broadband source models for crustal earthquakes in Japan.

Total 22 articles for 13 earthquakes with the moment magnitude Mw from 5.7 to 6.7 occurring to April, 2011 are used in this study. The numbers of the strike-slip, reverse, and normal faults are six, six, and one, respectively. We independently treat each source model for the same earthquakes, and so the total 25 source models are examined. We also independently treat each strong motion generation area.

The relations between stress drops stress [MPa] on SMGAs and the center depths h [km]are shown in the attached figure. The equations (1), (2), and (3) are derived from three data-set for strike-slip, reverse, and all-types faults, although the standard deviations of the regression relations are large.

stress=0.63h+7.88 (standard deviation=5.26) strike-slip (1)
stress=1.42h+8.54 (standard deviation=8.39) reverse (2)
stress=1.15h+7.98 (standard deviation=8.05) all (3)

The stress drops for reverse faults are larger than those for strike-slip faults at the same depth.

We also derive the relations between seismic moment M0 [dynecm] and total areas of SMGAs Sa [km^2] for strike-slip, reverse, and all-types faults as shown in equations (4), (5), and (6).

$Sa=4.57*10^{-16}M0^{2/3}$ (standard deviation=0.18) strike-slip (4)
$Sa=3.64*10^{-16}M0^{2/3}$ (standard deviation=0.09) reverse (5)
$Sa=4.02*10^{-16}M0^{2/3}$ (standard deviation=0.15) all (6)

Sa for strike-slip, reverse, and all-types faults are 0.9, 0.7, and 0.8 times of total area of asperities by Somerville et al.(1999). The result that total area of SMGAs are smaller than total area of asperities is interpreted by frequency-dependent source radiations (Satoh, 2010).

Short-period spectral level A which means the flat level of acceleration source spectrum (Dan et al., 2001) is represented by equation (7) based on the crack model (Brune, 1970).

$A=4pi(Sa/pi)^{0.5}stress\ Vs^{2}$ (7)

Here Vs is S-wave velocity of source and pi is circle ratio. We calculate A by substituting equation (1) to (6) for (7) assuming Vs=3.4km/s. The resultant A for all faults with depths of deeper than 7 km is larger than A derived from the M0-A relation by Dan et al.(2001). The A for strike-slip faults with depths of deeper than 10 km and reverse faults with depths of deeper than 5 km is larger than A by Dan et al.(2001).

As mentioned above, we derived the empirical relations that the stress drop is large, so that strong motion generation area is deep. In addition we showed that the stress drops for reverse faults were larger than those for strike-slip faults at the same depth. The relations between stress drops and depths would be useful for advancement of strong motion predictions for crustal earthquakes.

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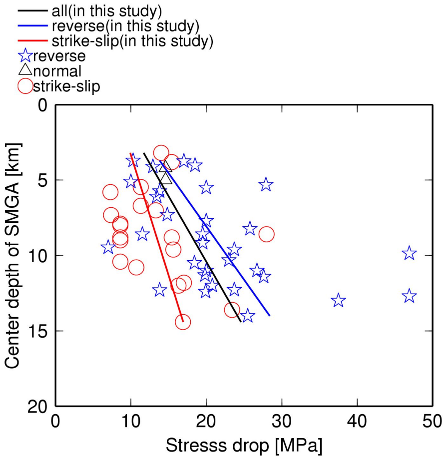
Keywords: strong motion generation area, stress drop, depth, empirical Green's function method, crustal earthquake


all(in this study)
reverse(in this study)
strike-slip(in this study)
reverse
normal
strike-slip
Center depth of SMGA [km]
Stresss drop [MPa]
0
5
10
15
20
0
10
20
30
40
50