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

SSS26-06 Room:304 Time:May 20 10:45-11:00

Scaling relations of source parameters for great earthquakes on long active fault systems and plate boundaries

TAJIMA, Reiko[1*], Yasuhiro Matsumoto[1], SI, Hongjun[1]

[1]Kozo Keikaku Engineering Inc.

We investigated seismic scaling relations of rupture area (S), average slip (D), combined area of asperities (Sa) and short-period source spectra (A) versus seismic moment (Mo) for 6 crustal earthquakes with Mw >= 7.5 on long active fault systems and 6 plate-boundary earthquakes with Mw >= 8.4, to examine the validity of the scaling relations derived by past-study, and to understand the difference between source parameters derived from long-period source models with heterogeneous slip and short-period characterized source models. This study is a part of results of the contract study "Comparative study of scaling relations of source parameters for great earthquakes on long active fault systems and plate boundaries" from the Nuclear Safety Commission of Japan.

For the crustal earthquakes we found that the Mo-S relation fits in the line derived by Murotani et al. [2010] which is assuming a proportion to Mo^1 (Figure. 1a). The relationship corresponds to the third stage in 3 stage scaling model [Irikura et al., 2004] which is caused by the saturation of maximum displacement (Dmax) at approximately10 m. This is also confirmed in our result of the Mo-Dmax relation. The Mo-Sa relation derived from long-period and short-period models are similar to each other. The S-Sa relation seems to fit in the scaling relation suggested by Somerville et al. [1999]. The Mo-A relation is within a scattering of relationship by Dan et al. [2001].

For the plate-boundary earthquakes we found that the Mo-S relation is clearly smaller than that by Murotani et al. (2008) for the M9 events. We also found that the fault widths seem to saturate at approximately 200 km from our results. Then we derived the following new scaling relation S and Mo for great plate-boundary earthquakes with Mw >= 8.4 (Mo >= 4.4 x 10^{22} Nm) assuming a proportion to $Mo^{1/2}$:

S (km^2) = 5.88 x 10^{-7} x $Mo^{1/2}$ (Nm) .... (1).

This corresponds to the second stage in the 3 stage scaling model that is caused by the saturation of fault width due to the restriction of the seismogenic layer in the subduction-zone. We also confirmed that D and Dmax are not saturated, i.e. the relation does not arrive at the third stage in the 3 stage scaling model yet. The Mo-Sa and S-Sa relations derived from long-period models fit in the scaling relations suggested by Murotani et al. [2008]. However the Mo-Sa relation derived from short-period models is 2.5 times as small as that of long-period models, and matches the scaling relation by Sato [2010] using the plate-boundary earthquakes. The Mo-A relation is higher than that by Dan et al. [2001] using the crustal earthquakes, but fits in the relation by Sato [2010] using the plate-boundary earthquakes. We think that it is important to accumulate more source models with the different period range because we could discuss about only the 2011 Tohoku earthquake for the plate-boundary earthquake in this study.

Keywords: great earthquake, source parameter, source model, scaling, asperity, rupture area

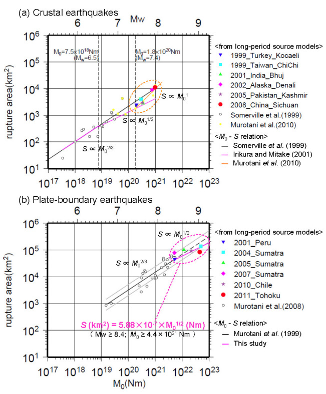

Figure 1. Relation between rupture area (S) and seismic moment (M_0).