Quasi-Dynamic Earthquake Sequence Simulation of the Median Tectonic Line Fault Zone Considering the Stress Field around Shikoku

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In this study, we perform quasi-dynamic earthquake sequence simulation for the Median Tectonic Line Fault Zone (MTLFZ) to discuss the factors that define earthquake sequences in the MTLFZ based on mechanical failure criterion and friction laws. Then, we calculate the average slip velocity and average recurrence time for reproducible earthquake sequences and compare them with the average displacement velocity and average activity interval for each segment obtained from geomorphological and geological studies (e.g., Okada et al., 1998) to verify the validity of the MTLFZ model and the setting of friction parameters.

We consider the regularized rate- and state-dependent friction law (Lapsuta et al., 2000) on fault surfaces, and couple with quasi-dynamic equilibrium equation with a radiative damping term (Rice, 1993) that approximates the inertia effect. About the setting of dip angle, we consider the vertical case suggested by the trench wall near the ground surface westward of the northern margin of the Ishizuchi Mountains (e.g., Okada & Tsutsumi, 1997) and lateral movement of the MTLFZ, and the north dipping case estimated by seismic reflection surveys at shallow depths in the Toyo Kaikyo-Yufuin segment (e.g., Senda et al., 2004, Beppu-Mannenyama Fault Zone Focused Investigation Report, 2017). The stress field around Shikoku and geodetic observations are reflected in the stressing rate, as the rake angle on each fault plane is given by the results of stress inversion using focal mechanisms around the Shikoku area, and the absolute value of the stressing rate is given by the strain rate tensor, which is calculated from GNSS data by removing the contribution of elastic deformation due to interplate coupling on the subducting plate interface along the Nankai Trough. (Nishimura, 2017).

For a simple model with all fault planes vertical and uniformly loaded stressing rate, we obtain a recurrence time of ~550 years and an average slip rate of ~6km/kyr, given a typical stressing rate of 6.4MPa/kyr from GNSS data and a slip weakening distance of d_c=20mm. The mean slip velocity is in harmony with the mean displacement velocity of ~8m/kyr in the eastern part of the southern margin segment of the Sanuki Mountains (Okada, 1970) which is relatively active in the MTLFZ, but the mean recurrence time is slightly smaller than the mean activity interval of ~1500 years in the eastern part of the southern margin segment of the Sanuki Mountains(Goto et al., 2003). Since the mean recurrence time is positively correlated with the slip weakening distance d_c, assuming a larger d_c may better reproduce the observations.

Keywords: Median Tectonic Line Fault Zone , Quasi-Dynamic Earthquake Sequence Simulation

