Dynamic rupture process of the Tottori earthquake with a bending fault model

Changjiang Wu[1], Minoru Takeo[2]

[1] Earth and Planetary Sci., Univ. of Tokyo, [2] ERI, Univ. Tokyo

The Western Tottori-Prefecture Earthquake occurring on October 6, 2000 was the largest inland earthquake with magnitude of 7.3 by JMA scale after 1995 in Japan. The most striking feature of this earthquake is its bending strike of the aftershock. Some studies divided the fault system into several sub-parallel or intersection fault planes according to their refined aftershock locations. However, due to the resolution as well as the difficulty from the finite difference method, we simple adopt a bending fault as our fault model.

Rupture process of the Western Tottori Earthquake was revealed by strong motion waveform inversion with a bending fault model. The total rupture had duration about 9 seconds, with a moment of 1.2x10E19Nm.Large slip was mainly confined from depth of 3km to 6km. Slip sharply tapered to small value while approaching the ground surface. Our result show that 2.5 seconds of apparently silent rupture was also observed and large rupture started at 10km deep from 2.5 seconds on. The rupture essentially occurred in the south part in the first 5 seconds.

In order to investigate the role of the bending fault, we also simulate its dynamic rupture process. We use results of the kinematic rupture (i.e. strong motion inversion results) as the boundary conditions, take the stress continuity into account, and adopt the finite difference method to resolve the motion equations in a 3-dimensional continuum. Free surface condition as well as layered velocity structure is also included during simulation. We introduce a mapping method able to exactly follow the bending fault.

Kadinsky-Cade and Barka (1989) showed that epicenters of earthquakes are usually located in dilatational fault segments near the fault bend points. The Tottori earthquake supported his observation. Deviation of the northern fault segment has an effect of restraining bend. The restraining bend may not only account for the initiation of rupture but also the time delay of the rupture on the northern fault segment. Such a time delay is also observed by an experimental study (Kato et al. 1999). Kato et al. observed a time delay of 10.8ms to 3.5s to across the bend when the rupture propagation is restarted near the bend on the constraining fault segment.