1891年濃尾地震(M8.0)の動的破壊過程

Dynamic Rupture Propagation of the 1891 Nobi, Japan, Earthquake (M8.0)

福山 英一[1]; 三雲 健[2]
Eiichi Fukuyama[1]; Takeshi Mikumo[2]

[1] 防災科研; [2] メキシコ国立自治大学
[1] NIED; [2] UNAM

The 1891 Nobi earthquake was the largest intraplate earthquake that occurred in recent 200 years in Japan. Although it occurred more than 100 years ago, there are several photographs with geological descriptions (Koto, 1893, J. Coll. Sci. Imp. Univ. Tokyo) as well as the fault offsets, some of which still remain on the surface.

We constructed the fault model based on Mikumo and Ando (1976, J. Phys. Earth), who used the field survey results of the fault traces by Matsuda (1974, Spec. Rep. Earthq. Res. Inst.). The fault model consists of 5 subfaults, three of which form the curved northwestern segment and the rest two are for the branched faults. One of the branch segments are assumed to be buried whose top margin depth is 1km. We took into account the principal strain distribution in this region measured by triangular survey for 100 years (Geographical Survey Institute, 1999). Concerning the hypocenter location, there are two possibilities: the northern end (Mikumo and Ando, 1975) and the southern edge of the northern subfaults (Muramatu et al., 2002). If we considered the arrival time differences of the initial P- and S- waves recorded at Gifu and Nagoya, the northern edge is more probable, and we used this location as the hypocenter. We also assumed that the rupture started at a depth of 10 km, and that pure strike slip occurs down to a depth of 15 km.

We computed a spontaneous rupture propagation based on the boundary integral equation method with triangular elements (Fukuyama et al., 2002, AGU Fall Meeting). In this computation, a slip-weakening constitutive law is employed with exponential decay and the critical slip-weakening distance of 1m. We assumed a uniform tri-axial stress field around the fault system, and the yield and frictional stresses are computed from the normal stress multiplied by static and dynamic coefficients of friction, respectively.

A series of computations tells us that since the rupture has to propagate a long way (55km) up to the junction before changing its direction, the rupture velocity becomes very sensitive to the stress field applied and it becomes rather easy to propagate with super-shear speed in order to make the rupture propagate along both of the branched subfaults. In this fault geometry, since the branch angle is large enough (44 degrees), there are no interactions between the branched faults, which are the same as shown by Aochi et al. (2000, GRL). Another critical parameter was the direction of the principal stress. We first used N105E for the maximum principal stress direction, which is consistent with the principal stress direction (Geographical Survey Institute, 1999), but the dynamic simulation prefers to N90E in order for the rupture to propagate along both of the branched faults.

These investigations provide us with additional information on the old earthquake whose rupture process is not well known. These approaches are found to be very useful especially for the case of insufficient information on the earthquake rupture.