Examination of consecutive rupturing of two close active faults by dynamic rupture model

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1.Introduction

It is very important to interpret the relationship between the active fault observed on the surface and the earthquake-source fault in the seismogenic layer by a physical model for predicting the strong ground motions and the crustal deformation caused by earthquakes. In particular, it is a must to judge if the plural faults close to each other will rupture at once or not for predicting the magnitude of the hypothetic earthquakes. Hence, in this paper, we examined the fault conditions of consecutive rupturing in the cases of different distances between the two faults on the common plane, different strike changes of the two faults, different locations of the initial crack, and different distances between the two parallel faults.

2.Faults model and friction law

We examined two faults with the same width, but different length. One was 30 km long and 15 km wide, and the other was 20 km long and 15 km wide. The density of the medium was 2.7 g/cm3, the P-wave velocity was 6.0 km/s, and the S-wave velocity was 3.5 km/s. The calculations were performed by 3D FDM of Kase and Day (2006), and the grid size was 0.25 km. We applied a slip weakening law to the friction law on the faults. The dynamic stress drop was 4 MPa, the strength excess was 6.4 MPa which was 1.6 times of the stress drop, and the critical distance was 0.25 m.

3.Relationship between the distance of the faults on the common plane and consecutive rupturing

We changed the distance of the faults on the common plane from 0 km to 5 km. The results showed that the second fault was easier to rupture when the fault-to-fault distance was smaller and that the critical distance was about 2 km (Figure 1).

4.Relationship between the strike change of the second fault to the first fault and consecutive rupturing

We changed the strike of the second fault to that of the first fault from -30 degrees to 30 degrees. The results showed that the second fault was easier to rupture when the strike of the second fault was changed more largely to left for the left-lateral fault system.

5.Relationship between the location of the initial crack and consecutive rupturing

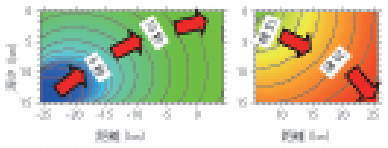
We examined two cases of the location of the initial crack on the longer fault and on the shorter fault. The results showed that the second fault was easier to rupture when the rupture started on the longer fault than when the rupture started on the shorter fault (Figure 2).

6.Relationship between the distance of the parallel faults and consecutive rupturing

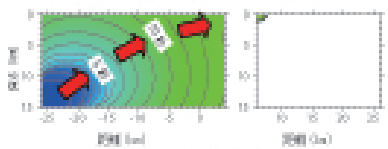
We changed the distance between the parallel faults from 0.75 km to 5 km. The results showed that the parallel faults were remarkably difficult to entirely rupture and that the second fault started to rupture but failed to expand the rupture even in the case of the fault-to-fault distance of 0.75 km (Figure 3).

7.References

Kase and Day (2006): Spontaneous rupture processes on a bending fault, Geophysical Research Letters, 33, L10302.

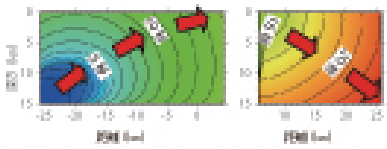


(a) 離間距離 1.5km の場合



(b) 離間距離 2.0 km の場合

図1 離間距離と連動破壊との関係



(a) 長い断層がはじめに破壊する場合

(b) 短い断層がはじめに破壊する場合

図2 隣り合う2枚の断層の破壊順序と連動破壊との関係

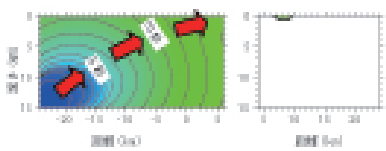


図 3 並行断層の連動破壊