Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)


SSS28-P02 Room:Convention Hall Time:May 23 18:15-19:30

# Numerical simulations for interactions of dynamic rupture on fault step-over

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Fault system on the Earth's surface consists of some segments with various structures such as bending, branching, and stepping. A part of stepping faults overlaps each other in many cases. In this study, we investigate interaction of dynamic rupture between two or more parallel planar vertical strike slip faults, and rupture stop in an overlapped zone, by spontaneous fault rupture simulations.

We used staggerd-grid split-node method (Dalguer and Day , 2007). As for the friction law, we assumed slip-weakening relationship. The initial stress field is assumed to be uniform, and elastic modulus is homogeneous. Assuming the three-dimensional orthogonal coordinate system, x axis is taken parallel to a fault plane, y axis is perpendicular to the fault, and z axis is taken downward(Earth's surface is z= 0 km). A fault is located in spatial range of -15 km<x<15 km, y= 0 km, and 0 km<z<15 km.This fault is hereafter referred to as Fault 1.The initial rupture zone is set in the central part of Fault 1. The second fault, which is Fault 2, is located in spatial range of -15 km<x<35 km and 0 km<z<15 km, changing the distance between the two faults in the y direction. Left lateral-strike slip faults were assumed, and extensional step was considered.

As a result, dynamic rupture of Fault 2 was triggered at the point located at the edge of Fault 1 (near x= 15 km) in all cases. After rupture was triggered on Fault 2, the rupture spread on the fault plane. In the overlapped zone, however, rupture on Fault 2 stopped spontaneously. This can be interpreted that shear stress drop in the overlapped zone on Fault 2 took place due to slip on Fault 1, causing difficulty for shear stress to reach strength on Fault 2. Simulated results for changing distance between the two faults showed that the smaller the distance is, the easier rupture stops in the overlapped zone on Fault 2, whereas the longer the distance is, the more difficult rupture stops on Fault 2. This is because the smaller the distance between the two faults is, the more the effect of shear stress drop by slip of Fault 1 on causing rupture on Fault 2 is large in the overlapped zone, whereas the larger the distance between the two faults is, the smaller the effect is. However, if the distance between the two faults is larger than a certain value, rupture on Fault 2 itself was not triggered anymore.

Keywords: step-over, spontaneous rupture simulation, rupture stop, staggerd-grid split-node method