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# Modeling of Asperity in terms of Spatial Inhomogeneity in the Effect of Inelastic Pore Creation

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We recently found two nondimensional parameters governing dynamic fault slip behavior: Su and Su' (Suzuki and Yamashita, 2010). The parameter Su represents the relative dominance of the effect of inelastic pore creation on the fluid pressure change over that of shear heating while Su' is associated with the dominance of fluid flow effect over the effect of shear heating. We show here that asperity can be modeled as a region having a locally small value of Su; the parameter Su' is assumed to be spatially homogeneous. We assume an antiplane shear fault embedded in a 2-D thermoporoelastic medium. The spontaneous fault tip growth with the Coulomb failure criterion is allowed on the whole fault plane.
We first consider a single asperity. The region where Su is relatively large is assumed to exist on the fault, in which dynamic fault rupture growth is initiated. The fault tip then enters the region where Su is relatively small. The spatiotemporal slip change shows that the rupture in the large-Su region slowly extends and induces locally large fault slip in the small-Su region. The fault tip growth is accelerated when the fault tip enters the small-Su region and the large fault high-speed slip is then induced. This behavior implies that the small-Su region can be regarded as an asperity generating locally large fault slip and seismic waves. The inhomogeneity in Su can be concluded to explain the difference between the asperity and surrounding regions.
We then assume two neighboring asperities and consider how these two asperities behave dynamically. The value of Su is assumed to be only locally significantly large at the center of the region. This large-Su region can be regarded as a spatial interval between the two asperities. The spontaneous fault tip growth initiates in one of the asperities. The spatiotemporal change in the slip distribution shows that two large earthquakes occur in two asperities with time delay. If the values of Su in the asperities are smaller, the magnitudes of the earthquakes are larger. If the value of Su in the large-Su region is larger, the time interval between the two earthquakes is longer. Especially, two earthquakes are observed as a single earthquake if Su in the large-Su region is sufficiently small. Detailed information about the inhomogeneity in Su is required for forecasting subsequent dynamic earthquake slip behavior. In addition, temporal change in tectonic time scale in the parameter Su is important for evaluating whether the earthquakes occur simultaneously or not.

Keywords: inelastic pore creation, spatial inhomogeneity, asperity, seismic linkage