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Earthquake rupture on poroelastic bimaterial interface: modeling of aseismic slip

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We theoretically study the mechanism of aseismic fault slip taking account of poroelastic effects including fluid flow. One of typical aseismic fault slip phenomena will be slow slip event discovered recently. A two-dimensional in-plane shear fault is assumed on a bimaterial interface that separates dissimilar poroelastic media. Only the diffusivity is assumed to be different in the two media. We carry out numerical analysis based on the analytical expressions for the stress tensor components and fluid pressure written as integral of fault slip gradient, which was derived by Suzuki and Yamashita (2008). The Coulomb failure criterion is assumed for the analysis of fault growth. We find that the fault extends unilaterally in the direction of slip in the medium of higher diffusivity; the extension distance of fault is larger for larger diffusivity contrast. The maximum extension distance is observed when the fault plane is impermeable. We also make simulation for a model in which the contrast between the two media exists only in drained and undrained Poisson's ratios; the comparison denotes that the diffusivity contrast is more effective for the quasi-static fault growth than the contrast in Poisson's ratios. We find that the released moment is approximated well by a linear function of duration of fault growth. This is largely different from expected from dynamic crack model; the moment is proportional to the square of fault growth duration if 2-D classical crack model is assumed. Such difference was also pointed out in the seismological data analysis of slow slip events and low-frequency earthquakes [Ide et al.,2007].