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Seismic wavefield generated by shear dislocations in a structure with a bimaterial interface and near-by cracks

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We develop a computational framework to calculate seismic wave propagation in a damaged fault zone structure, consisting of two welded quarter spaces of different elastic properties with various distributions of cracks in the slower medium near the interface. The incident wave corresponds to a strike-slip shear dislocation, and the total wavefield is calculated at observation points along lines perpendicular to the strike of the fault. The full waveform simulations incorporate the multiple scattering among the cracks, a vertical bimaterial interface and the free-surface. We use a Boundary Integral numerical scheme based on artificial wave-source distribution around the boundaries of all cracks [1], for which both the displacement and stress Greenś functions due to each source are computed exactly using a kernel analytical solution derived by the Cagniard-de Hoop method [2]. Examined case studies include several realizations of crack distributions, crack sizes and aspect ratios. The results show head and body waves, expected from previous related model of a bimaterial interface separating two homogeneous quarter spaces, and scattered wavefield generated by the cracks. For wavelengths much larger than the cracks size, the presence of cracks reduces the average wave speeds and increase the seismic attenuation compared to the properties of the hosting rocks.

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[2] Y. Ben-Zion, Geophys. J. Int., 98 (1989).