Wave propagation from a line source enbedded in a fault zone

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We compute the synthetic seismograms of the displacement field radiated from a seismic source embedded in a fault zone. It is revealed from analyses of shear-wave splitting and P-wave polarization anomalies that parallel cracks are densely distributed in a fault zone. Moreover observations of trapped waves revealed low-velocity and low-Q fault zone structure (e.g. Li *et al.*, 1994, JGR **99**). We assume following five models as a fault zone and investigate SH wave propagation in a 2-D elastic medium.

(1) A zone of densely distributed parallel cracks.

(2) An anisotropic zone whose elastic constants are equivalent to those of the crack distribution model (1) at the long-wavelength limit.

(3) A low-velocity zone.

(4) An anisotropic low-velocity zone.

(5) A low-velocity zone with densely distributed parallel cracks.

A seismic line source is located at the center of the fault zone and its radiation is assumed to be isotropic. Observation stations are located near the center of the fault zone. For the models (1) and (5), all the cracks are assumed to have the same length $2a$. We assume a periodic distribution of cracks in a zone and compute synthetic seismograms by the method introduced by Murai & Yamashita (1998, GJI **134**). For the models (2) and (4), elastic constants of the anisotropic zone can be obtained from the crack density by the relation given by Murai (2007, GJI **168**).

For the models (1) and (2), we cannot simulate the fault zone trapped waves. We therefore have to consider a low-velocity fault zone to excite trapped waves. For the models (3), (4) and (5), the seismograms show trapped waves and headwave refracted along the cross-fault material contrast. The amplitude spectra show the prominent peak in relatively low wavenumber range corresponding to the trapped waves. For the model (4), the low-wavenumber spectral peak split into two peaks because the interference of resonated waves in the layer occur at the wavenumbers different from that for the isotropic medium due to the wave speed depending on the propagation direction. For the model (5), the seismograms show the waves scattered by cracks in addition to the trapped waves. The amplitude spectra show the prominent peak at ka~1 in relatively high wavenumber range corresponding to the scattered waves, where k is the wavenumber. If the spectral peak is observable, we can estimate the crack length in the fault zone from the peak frequency in the high frequency range. Li *et al.* (1994) observed the spectral peak at around 10Hz in the fault zone of the 1992 Landers earthquake (M7.4) but did not infer the origin of the high frequency spectral components. If the spectral peak corresponds to the waves scattered by cracks, the dominant crack length is estimated to be about 60m by using the shear wave velocity of 2.0km/s (Li *et al.*, 1994).