Temporal change in shear wave splitting after a large earthquake

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Research on active faults, as well as the physical basis of earthquake generation itself, is important to accomplish the earthquake prediction. Moreover, fault behavior during an earthquake cycle should be completely understood. Sibson (1992) proposed a model of fault behavior called fault-valve action. The model predicts that physical properties of fault (for example, permeability and pore pressure) change during an earthquake cycle. However, a time scale and ranges of the changing values are not described in the model. To introduce a time axis and absolute values of parameters into such a fault behavior model leads to understand the fault behavior. Crampin (1978) first proposed that crustal anisotropy is caused by preferred orientation of vertical, fluid-filled microcracks. The shear wave polarized in the direction parallel to crack faces travels faster than the other shear wave. In contrast, fault-parallel fractures are generated by shear faulting during a large earthquake, and the first shear wave polarization inside of the fracture zone should be parallel to the fault strike. In addition, the fractures are closed by fault healing process, and the fault-parallel polarization disappears after the fault healing.

We performed shear wave splitting analyses for the two periods, 9-12 months and 33-45 months after the 1995 Hyogo-ken Nanbu earthquake at the Nojima fault. The first shear wave polarization changed during the two periods: the fault-parallel polarization disappeared 33-45 months after the mainshock. The fact strongly suggests that the fault-parallel fractures closed between the two periods, i.e., the fault healing at the Nojima fault completed within only 33 months after the mainshock.