

11 years long term monitoring of Seismic velocity near Nojima fault using ACROSS

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We have conducted a monitoring experiment of near fault seismic velocity for 11 years using an accurately controlled seismic signal system named ACROSS.

The aim of our study is to monitor the healing process of the fault after the rupture by the 1995 Kobe earthquake (M7.3) using ACROSS. The name ACROSS stands for Accurately Controlled and Routinely Operated Signal System, which continuously generate controlled seismic wave by centrifugal force from mass rotation. We deployed a couple of ACROSS sources in a source house just 300m away from the fault surface and the seismic signal generated by them is received by seismometers deployed at the bottom of 800m- and 1700m-deep boreholes just beneath the sources. The two sources are designed to generate same force of $2 \times 10^5 \text{N}$ by different rotation frequency of 25Hz and 35Hz respectively.

In this study, the source operation was repeated intermittently for 11 years from 2000 to 2012. We monitored the following three elements of the signal.

1. Travel time and amplitude of P and S waves. The both waves advanced about 4 per mill in the 11 years.
2. Travel time of S-coda phases. The coda part showed velocity increase (travel time advance) for 1 per mill, smaller than that of body waves.
3. S-wave splitting. The difference of velocity has been 10 % between the two S waves in the orthogonal vibration directions through the measurement period. The difference did not change to the detectable level.

If we assume the cause of the travel time advance to be a reduction of the crack density, the value is calculated to be 0.004-0.01 assuming random coin-shape crack. Previous studies reported that the permeability around the 1700m-deep borehole decreased by 50 per cent from 2000 to 2007. The decrease of the crack density qualitatively explains the permeability change. However, the permeability changed drastically while the change of the crack density is very small. This suggests that just disconnection or sealing of the water channels occurs without large change of crack density.

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