

## Estimation of hydraulic properties of fracture zone using strain changes due to the water injection experiments

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Water injection experiments were performed in 1997, 2000 and 2003 at the 1800m-deep borehole in the northwestern Awaji Island. The 1800m-deep borehole is located 500 m southeast of the Nojima fault. Co-seismic displacements over 1 m were occurred on the Nojima fault at the 1995 Hyogo-ken Nanbu earthquake. It is considered that fractures in the fault zone have been healing after the earthquake. In the experiments, many researchers measured permeability of the surrounding crust using the various observational data in order to investigate healing process of the fault. We reported hydraulic properties of the fault zone estimated using the observational data of strain changes.

Water injection experiments based on a scientific drilling program were performed in February - March 1997, January - March 2000 and March 2003. Water injected into the borehole was diffused in the surrounding crust at the depth of 540 m. Strain changes due to the water injection were observed with a multi-component borehole instrument installed at the bottom of the 800 m borehole. The instrument can observe strain changes in the directions of N21W-S21E(Str\_U), N81E-S81W(Str\_M) and N39E-S39W(Str\_D). Contraction of strain changes was observed in the period of the experiments. Time series of the strain changes showed exponential changes with relaxation time about a few days. Direction of the maximum contraction was N50E-S50W.

An ascendance of pore pressure due to water injection causes elastic deformation of the crust. We calculated time series of pore pressure changes using a diffusion equation and predicted strain changes due to the pore pressure changes. In this calculation, we assumed 2-dimensional flow of pore fluid. Strain changes due to the water injection depend on hydraulic properties, such as hydraulic diffusivity, hydraulic conductivity and channel of pore fluid flow. Calculated strain changes agreed with the observational data, when we assumed that pore fluid flowed on a vertical plane perpendicular to the Nojima fault. The direction of pore fluid flow shows the direction of fractures in the surrounding crust. Hydraulic diffusivities in 1997 and 2000 were determined to be  $1.1 \pm 0.1$  m<sup>2</sup>/s and  $0.5 \pm 0.1$  m<sup>2</sup>/s, respectively. The reduced permeability suggests that fractures in the fault zone have been healing after the earthquake.

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