Repeated Water Injection Experiments in the Nojima Fault: Studies of Fault Healing Process and Induced Earthquakes

Nojima Fault Water Injection Experiment Group

http://www2.rcep.dpri.kyoto-u.ac.jp/~chusuihp/

We carried out repeated water-injection experiments at the Nojima fault, southwest Japan in 1997 and 2000. The main purpose is to study a healing process of the Nojima fault ruptured by the 1995 Mw6.9 Kobe earthquake, by detecting a temporal change of fault-zone permeability. Water injection was conducted at 550 m depth in the DPRI 1800-m-deep borehole with a pumping pressure of 2.8-4.6 MPa and a total flow of 23-273 kl. Decrease in permeability, up to about 50%, of rocks around the fault was detected by continuous measurements of strain and groundwater discharge at the 800-m-deep borehole (about 50 m distant from the injection well), and also the electric potential on the ground. This suggests a healing process of the Nojima fault zone advancing from 1997 to 2000. We will make sure the reliability of these estimates in the third experiment in March, 2003.

We observed increase in ultra-microearthquake activity (M -2 to 1) at about 2.5-4.5 km distances from the injection point and about 4-7 days after the beginning of each episodic water-injection. This space-time migration can be explained by a 2-D diffusion process of pore water pressure, and we estimate that these are injection-induced seismicities. These induced events showed following properties; clustering structure of hypocenters, migration of hypocenters, and smaller b-values than background earthquakes. Preliminary analysis of waveform characteristics suggests that induced events and background earthquakes occur in different clusters. The 1800-m-deep borehole seismograms recorded at 10 kHz sampling showed corner frequencies of the ultra-microearthquakes at about 40-250 Hz. Differences of the source process between induced and background seismicities will be discussed including the records obtained in the experiment in 2003.