

Secular change of hydraulic property estimated using strain changes due to the water injection experiments

Atsushi Mukai[1]; Kunio Fujimori[2]

[1] Faculty of Informatics, Nara Sangyo Univ.; [2] Earth and Planetary Sci., Kyoto Univ.

Water injection experiments were performed in 1997, 2000, 2003 and 2004 at the 1800m-deep borehole in the northwestern Awaji Island. In the experiments, many researchers measured permeability of the surrounding crust using observational data of crustal movements, discharge, seismicity and electromagnetic changes in order to investigate healing process of the Nojima fault. We report secular change of hydraulic property of the fault zone estimated using the observational data of strain changes due to the water injection.

Water injection experiments based on a scientific drilling program were performed in February - March 1997, January - March 2000, March - May 2003 and December 2004. Injected water was diffused in the surrounding crust at the depth of 540m in the 1800m-deep borehole. A multi-component borehole instrument was installed at the bottom of the 800 m borehole located 70m south-southwest of the 1800m-deep borehole. The instrument can observe strain changes in the directions of N21W-S21E (Str_U), N81E-S81W (Str_M) and N39E-S39W (Str_D). Strain change Str_U could not be observed during the experiment performed in 2004, because of some troubles in the observational system. Contractions of strain changes were observed during every experiment.

Ascendance of pore pressure due to water injection caused elastic deformation of the crust around the 800m-deep borehole. We calculated time changes of pore pressure using a diffusion equation and predicted strain changes due to pore pressure. Strain changes due to water injection depend on hydraulic properties, such as permeability and channel of pore fluid flow. Permeability in 1997, 2000, 2003 and 2004 were determined to be 2.6 ± 0.3 , 1.5 ± 0.5 , 2.1 ± 0.4 and 1.8 ± 0.3 m/s, respectively. The 800m-deep borehole was sealed in August 2000. Rapid ascendance of permeability in 2003 was caused by ascendance of pore pressure due to the sealing of the borehole. Change of permeability was negligible in the period from 2003 to 2004.

The scientific drilling program is a co-operative program of a university consortium led by the Disaster Prevention Research Institute of Kyoto University. This program is planned and managed through the great efforts of Prof. M.Ando and DPRI staff. We offer our heartfelt thanks for their work.