Effect of Pore Fluid on Strain changes at the Mikawa Crustal Movement Observatory

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The channel has been drilled about 300 m west of the Mikawa Crustal Movement Observatory (34.8N, 137.5E, H76m). Strain changes observed with the extensometers were in the order of 1E-7 for a few months after the commencement of the drilling. It is considered that the strain changes were caused by a descent of pore pressure due to a discharge from the channel. We predicted strain changes due to the drilling of the channel and estimated hydraulic properties of the surrounding crust.

The Mikawa Crustal Movement Observatory is located at Toyohashi city in the eastern Aichi prefecture. The horizontal observation tunnel was installed at the depth of about 50 m. Extensometers installed in the tunnel can observe strain changes in the direction of N26W-S26E (NS), N19E-S19W (NE) and N64E-S64W (EW). Continuous observations of strain changes have been performed since January 1973. Resolution of recording data is 2.5E-10.

The channel is planned to pass in the direction of north-northwest under the ground. The channel has been drilled since September 2002 with a rate of 3 m/day. Drilling area was about 700 m northwest of the observatory on January 2003. Discharge from the channel is 1E+5 - 4E+5 cc/min.

Strain changes of the NS component showed contraction for the early 100 days after the commencement of the drilling of the channel, and showed extension after that. Strain changes of the NE and EW components showed extension for the early 70 - 90 days, and showed contraction after that. It is considered that major part of the strain changes were caused by the discharge from the channel. We predict strain changes due to the drilling of the channel by the following procedure. At first, change of pore pressure is calculated using a diffusion equation. In this calculation, it is assumed that pore fluid flow occurs on 2-dimensional lateral plane. Secondary, elastic deformation of the crust is calculated using the pore pressure. Calculated strain changes agreed with the long-term changes of the observational data, when a hydraulic diffusivity was 0.01 m2/s.

Strainmeters were installed in three horizontal boreholes drilled nearby the observation tunnel in order to investigate the influence of the channel in detail. We will make more realistic model about strain changes due to the drilling of the channel using strain changes observed with the strainmeters, as well as strain changes observed with the extensometers.