# Stress field estimated from long term borehole deformations

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Temporal variation of Strain fields around the earthquake faults of 1995 Hyougoken-nanbu earthquake have been being measured with borehole 3-component strainmeters. The principal strain orientations determined from the strain change in the long term of more than 3 years are consistent with the other observations: the maximum compressional direction at Takarazuka and the maximum extensional direction at Ikeda are parallel to the strike of the fault. The maximum compressional direction at Ikuha is almost east-west. These directions are consistent with the stress field measured by the hydraulic fracturing measurements or the method using the borehole

breakout orientation. These results indicate that Tkarazuka and Ikeda observation points is positioned in the north edge of the fault and the deformations are still continued at the north edge of the fault where the stress filed is governed by the stress concentration due to the 1995 Hyougoken-nanbu earthquake. The deformation at Ikuha is also governed by the stress field measured just after the earthquake.

Sakata(2000) analyzed the long term volumetric strain changes measured by borehole strainmeters, interpreting the deformation as the rock creep of the Maxwell viscoelastic model for the borehole in the rock mass. We here interpret the differences of the strains in 3 components in the long term are due to the rock creep in the borehole under the anisotropic stress field. We propose a method to estimate a stress field from the long term of observation of t3 component borehole strainmeters.

We adopt the standard linear viscoelastic model for the present problem. The analytical solution of this problem was given by Cristescu(1989). Parameters for this solution is dynamic and static elastic moduli, viscosity coefficients, and stress fields. The parameters were searched to fit the observed data by trial and error. Estimated values of the parameters were almost consitent with the parameter values near the depth of the strainmeters. The estimated stresses at Ikuha, for example, are;Shmax: 11Mpa, Shmin:7.76MPa,Shmax direction: N110E. The stresses measured by hydraulic fracturing method are; Shmax: 14.1MPa, Shmin:9.7MPa, Shmax direction: not measured. The present method should be tested for other sites.