A new method for stress orientation measurements by using borehole deformation - Application to the Atotsugawa fault

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http://unit.aist.go.jp/igg/rg/seisprocess-rg/index.html

A new technique for a crustal stress measurement is tested near the active Atotsugawa fault, central Japan, to examine performances of a newly developed tool for measurement and to compare a measured crustal stress with results by other methods. Kuwahara et al.(2004) have proposed a new tecnique for measuring a crustal stress orientaion. A principle of the technique is to measure the creep deformation of the borehole just after drilling in the anisotropic stress field at the depth of 10 -20 m where the disturbance caused by thermally induced stress from surface is negligibly small. For designing a new tool for the measurement, we estimated the creep deformation 24 hours just after drilling to be about 1.0E-6 at a depth of 10 m. A new tool has been developed to measure the deformation: the laser displacement sensor in a borehole locking tool is continuously rotated around 360 degrees to measure radial displacement of borehole wall.

The measurements of creep deformation have been performed at two depths of 16.8m and 17.7m in a borehole with a diameter of 123mm. The borehole was drilled in a mine cavity near the Atotugawa fault. The results of the measurements are summarize as follows: 1) A theoretical eliptic borehole deformation has been successfully observed. Major and minor axes are elongated by 3-5 micro-m and shortened about by 5 micro-m, respectively. Almost all the amount of the deformations are achieved in a first few hours. 2) An orientation of the minor axis is ENE-WSW, which can be regarded as the maximum compressional stress direction. 3) Other creep deformations with various shorter wavelenghts than the theoretical anisotropic deformation have been observed. The amplitude of the short wavelength deformatons are compatible with the anisotropic deformation. These deformation are probably due to nonuniform distribution of viscoelastic prperties of rock.