

Three-dimensional analysis of stress measurements with stress relief technique using intelligent type strainmeter

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Recently, in situ stress measurements have been performed at many sites with the stress relief technique using the intelligent type strainmeter. In this technique, first, the instrument is installed at the bottom of a borehole filled with mortar. Mortar attaches the instrument to the surrounding crust. Second, a core with the instrument is obtained by overcoring. Principal stresses can be estimated by using strain changes due to overcoring. When we calculate principal stresses, it is necessary to consider the influences of elasticity of the instrument and mortar. In this study, we report the calculation method of three-dimensional principal stresses on the stress relief technique using the intelligent type strainmeter. We applied stress measurements at the Kamioka mine and Kikugawa to this calculation method and determined principal stresses at each site.

Mukai et al. (2004) suggested the two-dimensional calculation method of principal stress on a plane under consideration of three layers of stainless, mortar and crust in Seismological Society of Japan Autumn Conference 2004. This method cannot be used to determine three-dimensional stresses, although the intelligent type strainmeter consists of diagonal strainmeters as well as lateral strainmeters. In this study, we investigated three-dimensional calculation method of stresses under assumption of an infinite cylinder model with three layers of stainless, mortar and crust. In this model, stresses and displacements are continuous on the boundary between layers.

In the stress measurements at the Kamioka mine and Kikugawa, the intelligent strainmeters with a diameter of 22mm were installed in the borehole with a diameter of 36mm. The core obtained by overcoring had a diameter of 85mm, which was 3.9 times as large as diameter of the strainmeter and was 2.4 times as large as diameter of the borehole. The intelligent type strainmeter was developed by Nagoya University. The stress measurement at the Kamioka mine was performed at a vertical borehole with the depth of 35m in January - February, 2006. The stress measurements at Kikugawa were performed at the depths of 400m and 500m. The instrument can observe strain changes on the lateral plane in the 4 directions and strain changes in the 4 directions inclined to the lateral plane. We could calculate three-dimensional stresses by using strain changes due to overcoring.