

Stress orientation measurements around The East Matsumoto Basin faults by using borehole deformation at shallow depth

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The Itoigawa-Shizuoka Tectonic Line (ISTL) is one of the active fault systems in the Japanese Islands. An estimated 30-year conditional probability for a major earthquake recurring on the ISTL is very high at 14 %.

Stress state information along fault systems is thought to be important improving an accuracy of the long term prediction of earthquake occurrence on the fault systems. Although the stress field around ISTL can be estimated by microearthquake analysis, it is difficult to investigate the stress field in the area where the activity of microearthquakes is low. The region around the north segment of the East Matsumoto Basin faults (EMBF), which consist of the northern part of the ISTL, is found to have a low activity of microearthquakes. We, therefore, applied a new method for stress orientation measurement at shallow depth around the north segment of EMBF and evaluate the stress state from the distribution of stress orientations along the fault.

The principle of the new method is to measure the creep deformation of a borehole just after drilling in the anisotropic stress field. The orientation of the maximum horizontal compressive stress (SHmax) is able to be determined from a minor axis of an ellipse fitted to a deformed shape of borehole cross section. The advantage of this method is relatively simple and easy so that a multitude of measurements becomes possible.

We chose 3 sites for the measurement that are located at northern, middle and southern parts in the region with a low activity of microearthquakes, respectively. The distance from the fault to each site is 1 to 5 km. The technical conditions for selecting the sites are follows. Hard rock should be found at least at the depth of 10 m. It is preferable to keep away from precipitous topography to neglect a topography effect on the stress state. Three to five measurements at each site were conducted at different depths ranging from 11 m to 17 m.

The SHmax orientations estimated from the borehole deformation are in a range between NE-SW to NEE-SWW in general. The estimated orientation is found to have almost a right angle to the strike of EMBF.

Keywords: stress orientation, creep deformation, East Matsumoto Basin faults