Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SSS31-P02 Room:Convention Hall Time:May 21 18:15-19:30

Precision observation of seafloor pressure change on the platform of C0002 borehole observatory in Nankai Trough

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Long-term observation of seafloor and pore pressures off Kii Peninsula is important for the detection of the crustal movement, the monitoring of fluid migration around splay faults and also understanding the pre and post earthquake events in the focal region of the Tonankai earthquake. Pressure measurement contains the instrumental drift in pressure sensors in addition to the pressure changes associated with the crustal movement, fluid migration and etc. In order to remove the drift, the drift rate is estimated by the laboratory experiment. However, for the long-term observation over one year, it is difficult to quantify the behavior of the drift. In this study, we have conducted the precision observation of seafloor pressure change on the platform of C0002 borehole observatory for the development of the in-situ calibration method.

During the IODP Expedition 332 in December 2010, we deployed a long-term borehole monitoring system (LTBMS) with pressure gauges (Paroscientific Inc. 8B7000-2 and 8B7000-1) into C0002 riserless borehole in Nankai Trough to monitor the seismogenic behavior of subduction zone plate boundaries. Seafloor pressure and pore pressure measurements are continuously conducted since the deployment. In this January 2013, the C0002 long-term borehole observatory was connected to the Dense Oceanfloor Network System for Earthquakes and Tsunamis (DONET) for real-time monitoring during the KY13-02 cruise by the R/V Kaiyo. Therefore, the platform of C0002 borehole observatory is good target for the in-situ calibration study.

During the KY13-02 cruise, pressure gauge (Paroscientific Inc. 8B7000-2-005) was deployed on the platform of C0002 observatory by ROV Hyper-Dolphin and precise observation of seafloor pressure change were conducted for one hour. Prior to the cruise, the pressure gauge were precisely calibrated by the laboratory experiment. To reduce the effect of the pressure change, the gauge was pressurized at the target pressure under the seafoor temperature condition and the valve was closed in the laboratory. On the platform after the deployment, the valve was opened for the pressure measurement. Tilt sensor was also attached to the pressure sensor for the tilt calibration. We conducted the measurement twice on January 20 and February 1 for the repeatability evaluation.

The offset of the borehole pressure gauge from the absolute pressure value was 240 hPa. The repeatability of the measurement was 14 hPa within the specification of the pressure sensor(0.005%FS=34.5hPa), which is larger than the laboratory experiment. We found from the in-situ calibration that keeping the pressure condition is important for the precise pressure measurement. We will quantify the effects of the temperature change, tilt of the pressure gauge and the density change of the oil inside the gauge for the precise evaluation. Further, we plan to conduct the in-situ calibration at C0002 borehole observatory to estimate the long-term instrument drift and apply the calibration method to the DONET pressure gauges in Nankai Trough.

Keywords: Seafloor pressure observation, In-situ calibration, Nankai Trough, Borehole observatory, Crustal movement, Pore pressure