Evaluation of drift characteristics of pressure sensors for improving long-term pressure monitoring at seafloor

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This study focuses on the drift characteristics of pressure sensors used for seafloor pressure monitoring, on the basis of the experimental results obtained at calibration laboratory for years. Pressure sensors with high resolution and short-time stability have been used for detecting transient tectonic movements. To use these pressure sensors for long-term pressure monitoring at seafloor, and to quantitatively evaluate the vertical tectonic deformation from the pressure data, the drift characteristics of the sensors need to be precisely evaluated. In usual case, the drift behavior of a pressure sensor can be evaluated and estimated by repeating calibrations at a regular interval. Regarding seafloor pressure monitoring, however, it would be difficult to periodically collect and calibrate the pressure sensors installed at seafloor. Furthermore, the drift characteristics of pressure sensors depend on the conditions of use; the drift of the sensor used under constant high pressure application may be different from that measured with a typical calibration procedure. Thus, the drift characteristics of the sensors should be evaluated in the similar pressure condition as the actual use.
In this study, the drift characteristics of pressure sensors have been evaluated at the pressure calibration laboratory in National Metrology Institute of Japan to improve the accuracy of the seafloor pressure measurements for a long time period. The devices under test are quartz Bourdon-tube pressure sensors whose maximum allowable pressure is 103 MPa (15,000 psi). The pressure of 100 MPa has been applied to the test pressure sensors for a long period of time. During the pressure application, the sensors were calibrated at 100 MPa using a pressure balance as the standard. The calibration results, the deviation of the sensor's output from the standard value, at 100 MPa rapidly changed immediately after the pressure application. As time proceeded, the change rate became small and almost constant. After 140 days from the pressure application, one sensor was depressurized to atmospheric pressure. The calibration results at 100 MPa changed in the opposite direction and returned to the initial value after 90 days from the pressure release. In contrast, the other sensor, which has been kept at 100 MPa for more than two years, showed a constant drift. In addition, during the pressure application of 100 MPa, the pressure was intermittently released to atmospheric pressure for a short time, and the outputs at atmospheric pressure were also obtained. The results at 100 MPa and atmospheric pressure showed a similar trend, showing that the zero drift of the sensor is the main cause of the observed drift. From the experimental results, we discuss measures to appropriately evaluate and compensate the drift characteristics of pressure sensors used for pressure monitoring at seafloor.

Keywords: Pressure monitoring, Long-term drift, Pressure calibration

