Reducing and correcting long-term drift of pressure sensors used for ocean bottom pressure measurements

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Ocean bottom pressure (OBP) data provide useful information about the vertical crustal movements. There are a large number of observation points in offshore area of Japanese islands, and other earthquake zones in the Circum-Pacific earthquake belt. In addition to the vertical crustal movements of interest, however, OBP data are influenced by several factors, such as tsunamis, tidal fluctuations, seasonal variations in the amount of seawater, and instrumental drifts.

In this study, we focus on the long-term drift of pressure sensors used for OBP measurements. Quartz Bourdon-tube pressure sensors manufactured by Paroscientific, Inc. have commonly been used for OBP measurements due to its high resolution and stability. During seafloor pressure measurements, however, various types of long-term drift have been observed depending on individual products and pressure conditions. The drifts of the sensors are typically equivalent to the depth variation by several centimeters per year, which is similar to the variation caused by slow crustal movements. Thus, we need to reduce and correct the long-term drift to extract the reliable data.

The drift characteristics of Quartz Bourdon-tube pressure sensors have been evaluated at the pressure calibration laboratory in the National Metrology Institute of Japan (NMIJ/AIST). We continuously applied a target pressure to test sensors for a long time period, and repeatedly calibrated the sensors with a reference pressure balance. The long-term drift was evaluated from the variation in the calibration results according to time. The influential factors on the long-term drift, such as applied pressure, preliminary pressure conditions, and surrounding temperatures, were also investigated.
Based on the experimental results, we discuss practical measures to appropriately reduce and correct the long-drift of pressure sensors used for OBP measurements. One idea is preliminarily applying the measurement pressure to the sensor before an actual OBP measurement. It eliminates the initial large drift during the actual measurement. Another idea is internal calibrations at zero pressure during the OBP measurement. If the long-term drift can be attributed to the drift of zero-reading of the sensor, the drift at the seafloor pressure can be corrected in-situ by tracing the drift at zero pressure. We will introduce current activities for these ideas.

Keywords: ocean bottom pressure measurement, long-term drift, pressure calibration

