Evaluation of the RBR OBP's precision through laboratory pressurization experiments using pressure standard and sea trials

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An ocean bottom pressure gauge (OBP) is a sensor that can continuously observe the vertical displacement in the sea floor. The OBP manufactured by Paroscientific, Inc. is often used to measure crustal deformation. On the other hand, the power consumption of the system, including the data logger, is high, which is a limiting factor for the realization of long-term observation using a free-fall and pop-up recovery system, and the sensor itself is expensive. In recent years, less expensive OBP sensors have emerged with geophysical applications in consideration. In this study, we focus on RBR’s Duet3T.D, integrated with a data logger, lightweight, and low power consumption. On the other hand, the evaluation of the precision of this sensor compared to the sensor by Paroscientific has not been sufficient. Based on this background, this study evaluates the precision of RBR’s sensor and compares it with the Paroscientific sensor in laboratory experiments and sea trials.

The Paroscientific sensor has a pressure port that can be directly connected to a 1/16” pressure line, allowing direct pressure to be applied from the pressure balance. The RBR’s sensor, however, has a configuration where the pressure port is exposed to the outside of the sensor, so it cannot be pressurized from the pressure balance as it is. Therefore, a pressure-proof container was developed to connect the RBR’s sensor to the pressure balance, and pressurization was applied via water filled in the container. During the experiment, the Paroscientific and RBR sensors were connected in parallel and pressurized simultaneously. The experiments using the pressure balance were conducted as a set of five pressurization runs. After each run, the system, including the OBP sensor, was disconnected from the pressure balance, and pressure was maintained at approximately 40 MPa (which cannot be kept strictly constant due to changes in room temperature and other factors). By conducting one set of these experiments per week, we attempted to estimate the short-term stability and long-term instrument drift characteristics. The results showed that the outputs of both sensors were stable during the approximately 2-minute period in which the pressure balance was stably generating pressure, that the short-term variation was smaller for the Paroscientific sensor than for the RBR sensor, and that the former had a higher measurement resolution. On the other hand, the temporal fluctuations of the pressure over a period of about 2 minutes while the pressure balance was pressurized were in good agreement between the records of the two sensors. The RBR sensor, although providing less resolution than the Paroscientific sensor, has the potential to provide pressure data comparable to the Paroscientific sensor for measuring pressure fluctuations with a time constant of a few minutes by taking a time average of the measured values.

In addition, simultaneous observations of both sensors were conducted in the actual sea area. Furthermore, parallel observations of the Paroscientific and RBR sensors were performed during seafloor pressure observations to compensate for acoustic distance measurement observations in the northern part of the Sanriku-Oki region. Although the RBR sensor had a larger long-term drift component than the Paroscientific one, the two sensors showed good agreement over several hours. The results of these laboratory and field experiments suggest that the RBR sensor can provide seafloor pressure measurements of comparable quality to those of the Paroscientific sensor.

In the presentation, we will discuss the results in more detail using long-term laboratory experimental data and parallel observations in other ocean areas.

