Application of 9 years long ocean bottom pressure time series for the modeling of postseismic deformation following the 2003 Tokachi-oki earthquake

*Yuji ITOH[1], Takuya NISHIMURA[2], Keisuke Ariyoshi[3], Hiroyuki Matsumoto[3]

1. Graduate School of Science, Kyoto University, 2. Disaster Prevention Research Institute, Kyoto University, 3. Japan Agency for Marine-Earth Science and Technology

In the offshore region of Hokkaido, two ocean bottom pressure gauges (OBP) has been operated by Japan Agency for Marine-Earth Science and Technology (JAMSTEC) since July 1999 (Hirata et al. 2002). Because these OBPs are situated with submarine cable, it is not necessary to recover them to acquire data file and therefore continuous pressure time series data has been available until now. The 2003 Tokachi-oki earthquake (M_w 8.0) is a thrust event along the Kurile Trench and its source region was close to these OBPs. Co- and post-seismic pressure change was observed by these OBPs (Baba et al. 2006). We have modeled co- and post-seismic deformation following the 2003 Tokachi-oki to the 2011 Tohoku-oki earthquake using both onland GNSS and OBP time series data (Itoh et al. 2017, AGU). For the postseismic deformation modeling, some previous studies used OBP data for about 1 year following the mainshock but they used cumulative pressure change only, that is, they didn't use time series data (Baba et al. 2006; Sun et al. 2017). Therefore, application of OBP time series is a novel challenge in our study. In this presentation, we discuss the effect of incorporation of 9-years-long OBP time series for the modeling of postseismic deformation.

We used the OBP data starting from January 2002 with a sampling interval of 1 hour. First we removed tidal component using BAYTAP-08 (Tamura & Agnew 2008). Next, we down-sampled the detided data by averaging them for 1 day. Because correlation between the averaged pressure data and concurrently observed temperature data were found, as pointed out by Baba et al. (2006), we estimated correlating component using preseismic data and removed it from postseismic data. We modeled the residual preseismic time series with a linear function and an annual and semi-annual variation and removed its effect from the postseismic data by extrapolation. Here, we assumed that an instrumental drift was temporally linear because pressure change between 2000 and 2002 was linear within their error bar (Inazu & Hino 2011). Finally, we down-sampled the residual postseismic time series with an interval of 1 month. Co- and post-seismic uplift was observed at both OBP sites. For onland GNSS data, we used the same data set of Itoh & Nishimura (2017, JpGU). We constructed a model consisting of coseismic slip of the 2003 Tokachi-oki earthquake and M6-7 class earthquakes in the postseismic period, postseismic slip following them, viscoelastic relaxation due to these all slip and translation of the entire GNSS network and estimated co- and post-seismic slip distribution and the translation component.

The general pattern of the observed uplift at OBP sites was explained by the model which explained onland data well. In this study, we determined the relative weight of OBP to GNSS data based on OBP data fitting by trying several weights between 1 and 100 times and finally preferred 16 times. If we adapted smaller weight, the calculated displacement at OBP sites was smaller and therefore couldn't explain the observed uplift enough. On the other hand, with larger weight, the model became sensitive to fluctuation of time series. Slip magnitude in the trench side of OBPs was reduced by using larger weight, where M9 class tsunamigenic earthquake occurred in the 17th century (e.g., Ioki & Tanioka 2016). We conducted a sensitivity test with a couple of OBP weights. The result shows that larger weight is necessary to explain the observed uplift. Slip magnitude near the onshore region was well-reproduced regardless of the weights but offshore slip was not. For slip distribution, back-slip component was estimated in the

trenchside of OBP sites with the preferred weight to explain the observed uplift. This result suggests that OBP data assures smaller slip in the trenchside of OBPs than in the deeper side on the plate interface but not absolute slip magnitude around OBP sites. To address this problem, seafloor horizontal displacement data such as GPS/A is important.

Keywords: Ocean bottom pressure gauge, Seafloor geodetic observation, Inversion analysis, Crustal deformation, Postseismic deformation, GNSS

