The influence of undersea sound velocity structure on the GPS/Acoustic seafloor geodetic observation

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We have been developing a system for precise seafloor geodetic observation with the GPS/Acoustic combination technique and deploying several seafloor reference points on the land-ward slope of the major trenches around Japan, such as Japan Trench and Nankai Trough. The primary purpose of our observation is to detect and monitor the crustal deformation caused by the subduction of the oceanic plate near the plate boundary. At each point, we carry out a campaign observation with several days using a survey vessel and revisit it once or twice a year. In this presentation, we present some positioning results using the new depth conversion formula of XCTD and XBT.

In this analysis, undersea sound velocity structure must be given to convert travel times of acoustic wave into travel ranges. However, it is difficult to get the sound velocity structure in the seawater from observations such as CTD, XCTD and XBT measurements with accuracy sufficient to our purpose, which is one of major error sources in this technique. Therefore, we are trying to estimate the acoustic velocity errors from the travel time residuals in the positioning analysis. By taking a proper strategy, the correction of sound velocity errors based on this estimation improves the final positioning result significantly.

However in spite of taking this strategy, the accuracy of a positioning result will decrease when a big error is included in the observation value which is used as an initial value. Therefore, improving the accuracy of the observation value becomes important.

A depth of XCTD and XBT probes are calculated from an elapsed time of free fall. The depth calculated from the official depth conversion formula has a significant difference from the depth of CTD which is determined from water pressure. Consequently an accuracy of sound velocity is deteriorated. Therefore the new depth conversion formula is proposed for correct observation (Kizu et al. 2005; Koso et al. 2005).

We used this new formula to seafloor positioning analysis. In the presentation, the results using the new depth conversion formula is reported.