Development of seafloor acoustic ranging system toward real-time observation

Yukihito Osada[1]; Motoyuki Kido[1]; Hiromi Fujimoto[1]; Yoshiyuki Kaneda[2]

[1] RCPEV, Graduate School of Sci., Tohoku Univ.; [2] JAMSTEC,IFREE,DONET

We have developed a short-range seafloor ranging system as a possible future application to the DONET (Development of Dense Ocean-floor Network System for Earthquake and Tsunami) cable system. We report on the trial observation with the seafloor acoustic ranging system and estimate the accuracy of the acoustic measurement.

The seafloor acoustic ranging system was based on the precise acoustic transponder (PXP). We have a few problems for the improvement of the resolution. One thing is the variation of sound speed. Another is the bending of ray path.

Accordingly a ray path of acoustic wave tends to be bent upward in the deep sea due to the gradient of the sound speed. The PXP consists of a 2.5-m tall monopod anchor, a pressure housing in the shape of a glass ball for batteries and electronics, and an acoustic transducer on the top. Although such a design would make the PXP to sway slightly due to bottom currents, the internal tilt meter and the compass would allow the effects to be corrected.

In 2007 we carried out the experiment for the seafloor acoustic ranging system. We deployed two PXPs at about 750 m spacing on Kumano-nada. The water depth is about 2035m. We collected the 660 data in this experiment during one day. The round trip travel time show the variation with peak-to-peak amplitude of about 18 microseconds. The residual variation in the round trip travel time after the correction of these effects showed that the range across this 750 m distance was measured with a peak-to-peak range of 8 mm. These results show that 70% of variation in the range could be explained by the effect of the variations in temperature and pressure. Finally we correct the effect of the change in attitude of the PXPs, using the data from the tilt meters and the compasses. This results shows the resolution of acoustic measurements is +/-2mm.

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