

Repeatability of GPS/Acoustic seafloor positioning carried out around Hawaii Island and the Japan trench

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Recent movements of the Japan Arc are precisely observed by the Geographical Survey Institute using GEONET (GPS Earth Observation Net work). Although it is very important to understand the movements and geophysical mechanism of the plate boundaries, most of the boundary areas are under the sea around Japan. We need to establish the new system for observation of the seafloor movements, because the space geodetic system cannot work in the water. We introduce the GPS/Acoustic system for seafloor geodesy. The essence of this approach is to determine the acoustic ranges to the seafloor transponders from the sea surface point above the center of the transponder array, while determining the location of the sea surface hydrophone using GPS.

We have developed GPS/Acoustic seafloor positioning system under the Ocean Hemisphere Program. To observe directly the plate motion of the Pacific Plate at ca. 6km water depth, the new precision acoustic transponder (PxP) system should transmit and receive an acoustic signal of 10 kHz with a precise delay time in the wide range over 10km. This system finds the position of the seafloor at several hundreds kilometers length at a baseline sampling a signal at a rate of 1 MHz. Moreover, the motions of a ship and buoy are corrected to use the GPS/A experiment on the sea surface in this system. In this system, it is the most important that variability of the sound speed in the seawater can be precisely estimated.

To construct the new system, we carried out GPS/A observation around Hawaii Island by the R/V Roger Revelle of the Scripps in November 2000 using 3 PxPs. Within 50 km at the center of the GPS reference station, three PxPs were deployed on the sea floor at 2700m, 3000m and 4500m water depth, respectively. CTD cast were carried out 9 times during the observation. Repeatability of the position of the PxP net was estimated to be ca. 5cm.

We deployed 3 PxPs on the seafloor seaward of the Japan Trench (280 km from the coast, depth around 5450 m). We carried out GPS/A observation in 2002 by the S/V Kaiyo of Japan Coast Guard. We received here acoustic signals at slant ranges more than 15 km. Although it is difficult to estimate the repeatability of the positioning of two PxPs, fluctuation of the positions is estimated to be le