Positioning Analyses at Miyagi Reference Point Using the Seafloor Geodesy Data

Akira Asada[1]; Tetsuichiro Yabuki[2]; Masashi Mochizuki[3]; Masayuki Fujita[4]; Mariko Sato[5]; Masato Nakamura[6]

[1] IIS; [2] Hydrog. & Oceanog. Depart.; [3] IIS, Univ. of Tokyo; [4] Hydrogr. and Oceanogr. Dept. of Japan; [5] Hydrographic Dept.; [6] Environmental & Ocean Engineering, Eng., Tokyo Univ

When we estimate seafloor crustal deformation, it is useful to construct networks with seafloor reference points and develop methods to analyze the crustal deformation. Inst. of Industrial Science, Univ. of Tokyo and Hydrographic and Oceanographic Dept., Japan Coast Guard have been developing a GPS/Acoustic seafloor geodetic observation system.

For extraordinary precision, we have constructed sixteen seafloor reference points that consist of four mirror-type acoustic transponders along the Japan Trench and the Nankai trough (including three points in Miyake). Miyagi reference point is located on the landward slope of the Japan Trench at the depth of 1700m. Four transponders are placed at four apexes of a square whose diagonal length is 1700m.

At present, there are two software programs to analyze the seafloor-geodesy data. One is developed by Prof. Asada(Tokyo University) and the other is developed by Mr. Fujita and others(JCG). Asada et al. (2003) showed that the former one (or software developed by Asada) was able to locate the positions of the seafloor reference points within several cm repeatability. Asada's algorithm consists of three phases. First we obtain the position of ship using the GPS data. We make observation of GPS at the land station and the sea station(ship) simultaneously, and analyze the KGPS-data. Second we analyze acoustic ranging. In this phase, 10kHz acoustic signal is used for precise ranging between seafloor and on-board transducers. Deformation of the acoustic waveform due to the Doppler shift during transmiting and receiving the measurement signal is evaluated for the precise ranging. Third we calculate the poison of the transponders using the acoustic ranging data and sound speed data which are derived from CTD and XBT measurements. Undersea acoustic velocity structure depends on time and place. So, CTD and XBT measurements are performed as many time as we can during the acoustic ranging. But. we cannot follow temporal and spatial change of the sound speed structure around the seafloor reference station completely. And so Asada has introduced the parameter of the average speed correction into his software to fit the acoustic ranging data.

It is important to estimate errors in the observed data such as GPS, propagating time, acoustic velocity. Asada's soft is based on forward modeling, and users must consider the errors by themselves to correct errors. Although we already obtained satisfactory results with Asada's software, we come up with possible improvements on this software as we accumulate the experience of the analysis with the software. For example, we don't know enough evaluation about its dependency on initial values or how much effect the error of the sound propagating speed has on the position of the transponders. Now we focus on the problems about the third phase mentioned above, and are developing another soft to overcome them.

In this presentation, we will report the results from the observations at the Miyagi reference point calculated with Asada's soft and the current state of the new software