Main Erorre Factors in the Observation of Seafloor Crustal Deformation

Daisuke Muto[1]; Keiichi Tadokoro[2]; Shingo Sugimoto[1]; Takashi OKUDA[3]; Tsuyoshi Watanabe[2]; Akinori Kimoto[1]; Ryoya Ikuta[4]; Masataka Ando[5]

[1] Grad. Sch. Env. Studies, Nagoya Univ.; [2] RCSVDM, Nagoya Univ.; [3] RCSVDM Center.Nagoya Univ; [4] ERI. Univ. Tokyo / JSPS; [5] Inst. Earth Sci., Academia Sinica (Taiwan)

Introduction

Interplate great earthquakes occur with a recurrence interval of 100-150 years along the Nankai trough. The 30-years probability of the occurrence of Tonankai and Nankai earthquakes is estimated at 60-70%. Since earthquake area of these interplate massive earthquakes is below the seafloor, it is necessary to observe seafloor crustal deformation with high accuracy.

We have developed the system composed of the Kinematic GPS positioning technique and repeatedly acoustic ranging and observe at the Kumano basin. We accomplished long-term repeatability of about 2-3cm in the horizontal components and detected plate motions. But it is desired to observe more accurately because the precision of our system is lower than that of the GEONET observations. Therefore we performed numerical experimentations for main error factors of our present system.

Observation and Analysis System

In our system, we carry out acoustic ranging from various directions of surface and solve the place of them. We put the position of GPS antenna on the ship by Kinematic GPS positioning. And we determine the position of the transducer on ship using attitude data by satellite compass and relative position between GPS antenna and transducer on the ship coordinate. We solve the distance between the transducer on the ship and the transponders on seafloor by travel-times employing one dimensional sound speed structure measured by the CTD sensor.

Method

It was assumed that main errors of our system were 1)positioning error of transducer on ship (by those of Kinematic GPS positioning and attitude), 2)temporal variation of sound speed structure, and 3)the spatial variation of sound speed structure. We simulated with setting these three factors and judged which factor mostly effected on positioning of seafloor transponder.

In the simulations, we made quasi-travel-time data and analyzed with same method of real observations. We evaluated how exactly the position setting can be solved through the technique. For contribution to more accurate real observation, we calculated using real data except for the quasi-travel-time. Calculations were based on the ship track and schedules of real observation, and used observed CTD data.

Result

1)The positioning error of transducer on ship also emerged large. 2)The temporal variations of sound speed structure can be well estimated in our algorism and its error was less than that of the other two factors. 3)On the other hand, error by spatial variations was greater than that by the temporal variations. In these result, we found that the problems of the error factors related to the above 1) and 3) should be resolved firstly.

Acknowledgement

I would like to appreciate sailors of research ship Asama in Mie Prefectural Science and Technology Promotion Center who help us in observations.