Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

SCG086-09 Room: Function Room B Time: May 25 14:15-14:30

Seafloor geodetic observation using two GPS/Acoustic ranging systems on sea surface

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Observations of seafloor crustal deformation are very important to understand dynamics of plate boundary that include strain accumulation processes, great interplate earthquake mechanisms. Our group, which consists of Nagoya Univ., Shizuoka Univ., and Tokai Univ., has been developing an observation system with the GPS/Acoustic combination technique for monitoring of seafloor crustal deformation at the Suruga bay and the Kumano basin. Repeated observations of seafloor transponder positions can reveal directly the seafloor crustal deformation in focal area of subduction zone in the observation areas. By using our observation system, we could detect coseismic deformation associated with M7 class offshore earthquakes at the Kumano basin [Tadokoro et al., 2006]. In addition, repeated observations within five years could detect the velocity of crustal deformation associated with subduction at the both observation areas where huge earthquakes repeatedly occur [Tadokoro et al., 2008].

Seafloor positioning accuracy by our observation system was +/-5 cm. With the positioning accuracy, it is difficult to detect various types of seafloor crustal deformations in the subduction zone within short time. To obtain a stable positioning solution, it takes more than two days to collect measurement data and to homogenize spatial variation of velocity structure in one observation to determine one weight-center position of seafloor transponders. Improvement of the positioning accuracy and reduction of the observation time are recent main issues. To solve the issues, we have been developing a new seafloor positioning analysis, which simultaneously estimate the positions of seafloor transponders and spatiotemporal variation of acoustic velocity. In addition, it is required to develop a GPS/Acoustic ranging system with multi stations of acoustic measurements on sea surface and seafloor. Our final goal is +/-1 cm accuracy of positioning within one day.

In this presentation, we will report results of observations with acoustic measurement at two points on sea surface and three points on seafloor and application of the observed data to the new seafloor positioning analysis. Moreover, we discuss an evaluation of comparison the estimated and observed spatiotemporal variations of acoustic velocity by the new seafloor positioning analysis and a continuous measurement of temperature and pressure under moored sea surface station.

Keywords: GPS, Acoustic Ranging, Seafloor Crustal Deformation