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Monitoring of seafloor crustal deformation using GPS/acoustic techniques at the Suruga trough

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Observation of GPS/acoustic techniques started from the study by Spiess et al. (1998). In Japan, this type of observation has been carried out at the Japan trench, Suruga trough, Nankai trough, and so on. At the present, the accuracy of seafloor positioning is 1 to several cm for each epoch. Velocity vectors at seafloor point are estimated through repeating observations. After the 2011 Tohoku-Oki earthquake, Sato et al. (2011) observed the clear crustal deformation at the seafloor. In addition, Ito et al. (2011) inverted coseismic slip distributions using GPS/acoustic data and onshore GPS data. To observe seafloor crustal deformation is crucial because great earthquakes often have hypocenter under the seafloor, such as Tokai and Tonankai earthquakes.

We observed two observation points across the Suruga trough from 2005 to 2011. Each observation period was about 6?12 hours. East point of the Suruga trough (SNE) was observed 13 times, and West point of the Suruga trough (SNW) was observed 14 times. This study reanalyzed all previous observation data, improving the data quality by following three processes.

1) Muting reflected wave from the sea surface or from the bottom of the vessel in the acoustic data.
2) Removing the acoustic data during the vessel's attitude data exceed a criteria.
3) Removing the acoustic data when the reception condition of GPS signals was unstable.

We estimated the displacement velocity vector with relative to the Amurian plate on the basis of the result of redetermining position of the seafloor point at each epoch. Residual RMS in one epoch improves by about 0.27 ms. The estimated displacement velocity vector is 4.7 plus-minus 1.2 cm/yr to N99W direction at SNE. Comparing our result with the GPS displacement velocity vectors estimated by GSI(Geospatial Information Authority of Japan), both results do not have a significant difference, showing the consistency with the result of onshore GPS measurement. Comparing our result with onshore GPS displacement velocity at the west Suruga trough, there is a significant difference of several mm/yr. This result imply that two plates bounded by the Suruga trough have been undergoing convergence.

Keywords: seafloor crustal deformation, GPS/acoustic techniques, Suruga trough, monitering, reflected waves