Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SSS34-03 Room:201B Time:May 23 16:45-17:00

Deformation of the Nankai forearc sliver and Median Tectonic Line

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The Nankai forearc sliver in southwest Japan, which is bounded by the Nankai Trough plate boundary in the front and the right-lateral Median Tectonic Line (MTL) in the rear, has suffered from interseismic crustal shortening in the direction of plate convergence and long-term lateral movement along the MTL. In the east of the forearc, the arc-arc collision between northeast Japan and southwest Japan seems to drive the forearc lateral movement forward. In contrast, there is no driving force for the forearc movement in the west of the region because the plate boundary rotates counter-clockwise off eastern Kyushu and an obliquity in the direction of plate motion against the strike of the plate boundary disappears. As a result the forearc lateral movement is transformed into a block rotation in the eastern and southern parts of Kyushu. Thus the lateral movement of the Nankai forearc sliver characterizes the long-term crustal deformation field in southwest Japan and the MTL is related to the major deformation sources. In addition the MTL itself has a potential to generate a large inland earthquake in the future. We think it is important to understand subsurface structure and current slip/locking pattern of the MTL fault plane.

Recent seismic reflection survey has revealed a gently northward-dipping geological structure around the MTL (Ito et al., 2009). Horizontal displacement field from dense GPS networks across the MTL has shown a right-lateral relative motion between southern and northern blocks across the MTL but a transition zone of the displacement field is located 20-30 km north of the MTL (Tabei et al., 2002). These patterns are well explained by a forearc lateral movement affected by a shallow locking and a deep aseismic slip on a northward-dipping MTL fault plane. In contrast, there is another observation result that is inconsistent to an interpretation of the dipping fault plane. A series of earthquakes have aligned 20-30 km north of and parallel to the MTL and most of them show a right-lateral slip on a nearly vertical fault plane. Unfortunately station distribution of the nationwide seismic and GPS networks is rather sparse in the north of the MTL because of the existence of the Seto Inland Sea. In this area we have deployed supplementary 10 seismic stations equipped with short-period, high-sensitivity seismographs and 3 GPS stations with dual-frequency receivers and collected continuous data since November 2010.

We propose that several vertical right-lateral fault systems exist above the northward-dipping fault plane of the MTL and they act as s shear zone between the Nankai forearc sliver and the inner zone of southwest Japan. The width of the shear zone is estimated as 20-30 km from the GPS displacement field, which is consistent with the zonal distribution of characteristic P-axis directions of earthquakes but about half of the width of the Setouchi shear zone proposed from a geological point of view (Tsukuda, 1992).

Keywords: Median Tectonic Line, Nankai Trough, crustal deformation, GPS