Structural factors controlling ruptures of mega-thrust earthquakes in the Nankai trough: results from wide-angle seismic studies

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Detailed slip distributions of the 1944 Tonankai and the 1946 Nankaido earthquakes become clear due to recent progress of tsunami wave data analysis (e. g., Tanioka and Satake, 2001, Baba et al. 2001). In general the co-seismic slips of the both event extended to near the deformation front off the Kii peninsula, while the large slips are only recognized at deeper part at the western (off Shikoku) and eastern side (off Tokai) edges of the Nankai trough. Similar pattern of the slips are also obtained by recent studies of near field strong ground motions data and/or teleseismic data (e.g. Hashimoto and Kikuchi, 1999; Cummins et al., 2001, Kikuchi and Yamanaka, 2001).

Active seismic studies aiming to investigate seismogenic structure have been extensively conducted in the Nankai trough since the last five years. Two remarkable structures have been imaged by wide-angle seismic studies at the western and eastern edge of the Nankai Trough, i. e., seamount subduction off Muroto and ridge subduction off Tokai (e.g. Kodaira et al. 2000, Nakanishi et al. Submitted). The wide-angle seismic data also provided a landward deepening of the Japanese island arc crust toward both end of the Nankai Trough. Here we define the Japanese island arc crust as a crustal body overlaying subducting oceanic crust with P-wave velocity of faster than 5 km/s. From these structures it might be proposed that the Japanese island arc crust is functioned as a deformable backstop of the present day accretionary process, and that the co-seismic slip mainly occurred at the landward of the proposed deformable backstop. An only exception is probably off the Kii peninsula where the tsunamigenic co-seismic slip extended farther seaward of the backstop. The slips in this area might be extended seaward as splay faults cutting through the accretionary sediments as suggested by multichannel seismic data (Park et al., 2002).

A remaining question concerning the Nankai seismogenic structure is why lateral propagation of mega-thrust earthquake in the Nankai trough has been mostly bounded off the Kii peninsula. Seismicity studies have suggested a sharp change in the slab dip or tear of the slab along the western coast of the Kii peninsula. A previous wide-angle study has also suggested structural variation along a profile parallel to the trough off the Kii peninsula (e.g. Mochizuki et al. 1998). If the structural variation and the proposed change in slab dip relate to the segmentation of the rupture zone, clear structural boundary would be imaged from incoming crust to subducted crust. We thus plan to propose a three-dimensional wide-angle seismic study covering from the seaward side of the trough to the land beneath the Kii peninsula.