Seismic velocity structure around the segmentation boundary between the rupture zones of the Nankai-Tonankai Earthquakes

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The Nankai Trough is a unique subduction zone because the recurrence intervals of M8 class earthquakes and the segmentation of rupture zones are well documented on the basis of geophysical, geological and historic data [e.g., Sangawa, 1998; Ando, 1975]. Recent crustal studies have revealed that a ridge and seamount subduction prevents the rupture propagation of the last 1944 Tonankai and the 1946 Nankai mega-thrust earthquakes [Kodaira, 2000; Kodaira, 2003]. Seismic reflection profiles revealed splay faults developed around the updip limit of the 1944 Tonankai Earthquake [Park et al., 2002]. Meanwhile historic Nankai-Tonankai Earthquakes always conjugated with each other, and segmentation boundary between their rupture zones is always located off the cape Shiono. A low velocity uppermost mantle underlying a subducting oceanic crust was found at the segmentation boundary by latest crustal study [Kodaira et al., 2004]. Our seismic study looks at the asperity area of the 1944 Tonankai Earthquake, and the segmentation boundary of the rupture zones of the Nankai-Tonankai Earthquakes to delineate the subduction structure related to the segmentation of rupture zones. The relation between the subduction structure and the 2004 offshore southeast of the Kii Peninsula Earthquake is also an interesting subject.

From Nov. to Dec. 2004, the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) acquired offshore wide-angle seismic data along two profiles crossing the Nankai Trough off the Kii Peninsula. The western profile, NT0404 (~180km), is located in the segmentation boundary between the rupture zones of the Nankai-Tonankai Earthquakes. The eastern one, NT0405 (~175km) is selected to cross the asperity area of the 1944 Tonankai Earthquake, where the splay faults developed in its updip limit. Thirty-six ocean bottom seismographs (OBSs) were deployed with spacing of 5km along the NT0404. Seventy-four OBSs were deployed along the NT0405 with spacing 1km around the splay fault area, 5km landward from the trough except for the splay fault area, and 10km seaward from the trough. For the seismic energy, a large airgun array with a total volume of about 200 l with a pressure of 14 MPa was fired at every 100m along the NT0404, and 200m along the NT0405 by JAMSTEC's R/V KAIYO. This research is part of 'Structure research on plate dynamics of the presumed rupture zone of the Tonankai-Nankai Earthquakes' funded by Ministry of Education, Culture, Sports, Science and Technology. Moreover, onshore-offshore wide-angle seismic survey was acquired in cooperation with the Kyoto University by recording explosive signals blasted for 'Regional Characterization of the crust in metropolitan areas for prediction of strong ground motion (The Kinki region)-Special Project for Earthquake Disaster Mitigation in Urban Areas', were recorded by OBSs on NT0404. Airgun signals were also recorded on the land stations of this project.

In this presentation, we show results of the NT0404 profile. Data quality is very good on all of 36 OBSs. First arrivals can be traced over 100km offsets except for a few OBSs around landward end of the profile. These arrivals were used to image a heterogeneous seismic velocity image down to the uppermost mantle. A preliminary seismic velocity image is derived by refraction tomography by using traveltime picks of the obvious first arrivals. We used a previously obtained crustal structure around the survey area [Nishisaka et al., 1996]. We found that a low velocity uppermost mantle (~7.5km/s) beneath the subducting oceanic crust at 10-60km landward from the deformation front. This structure may correspond to the abnormally low velocity uppermost mantle found at the segmentation boundary by latest crustal study as mentioned above. We will refine the seismic velocity image by combining the shallow sedimentary information, and refraction tomography keeping fixed the shallow structure.