Segmentation and rupture propagation in the Nankai seismogenic zone deduced from active seismic studies and a numerical simulation

Shuichi Kodaira[1]; Seiichi Miura[2]; Gou Fujie[3]; Jin-Oh Park[2]; Aki Ito[1]; Takane Hori[1]; Toshitaka Baba[1]; Yoshiyuki Kaneda[4]

[1] IFREE, JAMSTEC; [2] JAMSTEC, IFREE; [3] JAMSTEC; [4] JAMSTEC,Frontier,IFREE

The Nankai Trough, where the Philippine Sea Plate is subducting beneath the Eurasian Plate with a convergent rate of 2 – 4 cm/year, is well known as a mega-thrust seismogenic zone. The recurrence intervals of magnitude eight class earthquakes are 150 – 200 years, and four – six segments of the rupture zones are proposed. In order to image structural factors affected on co-seismic (seismogenic) and inter-seismic processes, a series of active source seismic surveys has been conduced both offshore and onshore of the Nankai margin since 1997. The most important finding from previous surveys is a ridge and seamount subduction preventing the lateral rupture propagation of the last 1944 Tonankai and the 1946 Nankai mega-thrust earthquakes. A remaining issue to be solved by seismic surveys is a structure controlling the segmentation boundary between the Tonankai and Nankai earthquakes. A progress of recent tsunami wave inversion showed a clear separation of the both rupture zones.

Wide-angle seismic data for imaging the segmentation boundary between the Tonankai and Nankai earthquake were acquired in January to February, 2004 along three margin parallel profiles (150 – 190 km long). We found that a low velocity uppermost mantle underlying a subducted oceanic crust at the segmentation boundary. The low velocity uppermost mantle is also interpreted to be attributed by serpentinized mantle, which is created by a hydration reaction along the fracture zone. We also proposed that strength of the subducting / incoming plate may be reduced in the presumed serpentinized mantle on the basis of a laboratory experiment investigating a degree of serpentinization and its strength. Another significant structure we imaged is a high velocity (Vp; higher than 6.5km/s) doming structure reaching at immediately blow a seafloor off the Shionomisaki. This structure is interpreted as the Shinomisaki igneous complex. One of the important point is that the high velocity doming structure is locally situated off the Shinomisaki and lie on the subducting oceanic crust.

In order to investigate how the structure of the subducting oceanic crust affect on the segmentation and cycles of large earthquakes in the Nankai trough, we conducted three-dimensional numerical simulation on the basis of a method described by Hori et al. (2004). Although Hori et al. (2004) only introduced a overall plate geometry, this study newly apply a realistic distribution of frictional parameters which is deduced from the active source seismic studies. The realistic distribution of the frictional parameters is very effective. Results of the numerical simulation successfully reproduce the segmentations and cycles of the large earthquakes reported along the Nankai trough of the basis of historical data. This research is part of a structure research on plate dynamics of a presumed rupture zone of the Tonankai-Nankai Earthquakes funded by Ministry of Education, Culture, Sports, Science and Technology.