Heterogeneous structure and microseismicity at the western Nankai trough, southwestern Japan

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Along the Nankai Trough, southwestern Japan, large interplate thrust earthquakes have occurred repeatedly with a recurrence interval of about 100-200 years. The most recent large interplate earthquake in the western Nankai trough was the 1946 Nankai earthquake. The rupture of the 1946 Nankai earthquake started off cape Shio-no-Misaki and extended to off cape Ashizuri. A recent Tsunami waveform inversion shows the spatially heterogeneous coseismic slip distribution off Shikoku Island [Baba et al., 2004]. In addition, seismic surveys show heterogeneous structure off Shikoku Island. Park et al. [2002] shows that the deep strong reflectors (DSR) tend to appear in the area which did not experience rupture during the 1946 Nankai earthquake. A topographic high of the subducting oceanic crust was revealed by Takahashi et al. [2003] and seems to coincide with the seaward extended coseismic rupture of the 1946 earthquake. The coseismic rupture may be affected by the heterogeneous crustal structure. Microseismicity would be expected to reflect the current stress state and helpful to understand it by comparing with other geophysical observations. In order to investigate relation among the heterogeneous crustal structure, coseismic slip distribution, and current microseismicity, we have conducted seismicity observation off Shikoku Island from March to May 2004. We deployed 30 pop-up type ocean bottom seismographs (OBS) and used 2 cable-linked ocean bottom seismometers off cape Muroto. Hypocenters were determined using a 3-D velocity structure, which was based on the results of previous seismic surveys on/off Shikoku Island [e.g. Takahashi et al., 2003, Kodaira et al., 1999, 2002]. Many of located earthquakes occurred in the trough axis and in and around the DSR. On the other hand, microseismicity is not observed near the subducting topographic high, where the coseismic rupture of the 1946 Nankai earthquake propagated. An interplate coupling may be strong at the subducting topographic high. Earthquakes at the DSR off cape Ashizuri were located near the boundary between the accretionary prism and subducting oceanic crust. Park et al. [2002] suggested that the DSR is a possible releaser of the shear stress along the interface between subducting and overriding plates. These earthquakes were located near the edge of the subducting topographic high and made several clusters. The earthquake clusters at DSR off cape Ashizuri would suggest difference of the interplate coupling depending on the heterogeneity of the crustal structure. Off cape Muroto, east of the observation area, the DSR was imaged closer to the deformation front than off cape Ashizuri. Earthquakes were located near the DSR and along the boundary between subucting oceanic crust and the island arc upper crust. The earthquakes near the DSR off cape Muroto may indicate locally locked patches in the shallower aseismic-seismogenic transition zone. The variation of the microseismicity relating to the heterogeneous structure suggests that the interplate coupling and seismic rupture during large interplate earthquakes could be controlled by the crustal structure variations.

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