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Subduction Structure beneath the Eastern Part of the Kii Peninsula, SW Japan, from Wide-Angle Reflection Experiment

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The Nankai trough region, off SW Japan, is a famous seismogenic zone of M8 class interplate earthquakes associated with the northwestward subduction of the Philippine Sea (PHS) plate. In 2006, an intensive onshore-offshore seismic refraction/wide-angle reflection survey was conducted in the eastern part of the Nankai trough area. This experiment, funded by JAMSTEC, was aimed to elucidate the geometry of the subducted PHS plate and inhomogeneous structure of in and around the recent rupture area of the Tonankai earthquake (M7.9) occurring in 1944. Our offshore line was set to cross the western margin of the asperity area of this event with NW-SE direction. The onshore seismic line, 87.8 km in length, was laid out in the eastern part of the Kii Peninsula, almost on the northwest extension of the offshore profile line. The geology of the eastern Kii Peninsula is divided to two parts by the Median Tectonic Line (MTL), one of the major tectonic boundaries in SW Japan. The southern part is characterized by Cretaceous-Jurassic accretionary complexes, whose northernmost part consists of high P-T metamorphic rocks (the Sanbagawa metamorphic belt). The northern part of the profile (north of the MTL) consists of older accretionary complexes, partly suffered from the Cretaceous magmatic intrusions. It is also noted that surveyed region involves an active area of very low frequency (VLF) earthquakes. Our profile line was crossing this area in its middle part. On this profile, 519 receivers were set to record 5 dynamite shots with 100-400 kg charge. The obtained records were of good quality, and, other than clear first arrivals, several wide-angle reflections were identified as later phases. The most prominent features in the records are very clear and strong reflections which could be traced in almost the entire profile, probably coming from the subducted oceanic crust and its surrounding regions.

The uppermost crust is determined both from inversion (extended time-term method and refraction tomography) and forward modelling (ray-tracing method). The uppermost structure north of the MTL is relatively simple and composed of a 1-2 km thick surface layer with Vp=5.0-5.4 km/s and a crystalline basement with a velocity of 5.6-5.8 km/s. The uppermost crust south of the MTL is rather complicated, showing lateral velocity variation with a characteristic wave-length of 5-10 km. An area of the Sanbagawa belt just south of the MTL is characterized by a lower velocity (5.5-5.6 km/s) and a slightly higher Vp/Vs ratio (1.76) as compared with those in the north of the MTL. The MTL itself is recognized as a northward dipping reflector with an angle of 45 degrees down to a depth of 15-20 km. Besides the MTL, several relatively flat interfaces are recognized at midcrustal depths of 10-20 km. The entire structure including the subducted plate was modeled by the forward analyses of the travel times and amplitudes based on asymptotic ray theory. The PHS plate in the southernmost part of the onshore line is mapped as a slightly northward dipping reflector at a depth of about 22 km. This depth is almost consistent with the position of the subducted oceanic crust in the northern edge of the offshore profile of our experiment. The reflection from the PHS is so strong even in the pre-critical region, indicating the existence of thin (-0.5 km) layer with a relatively low velocity of 3.5-4 km/s at the top of the PHS. Our seismic data as well as natural earthquake distribution indicate that the PHS plate change in the subduction angle from 5 to 20 degrees at a distance of 15-20 km from the southern edge of the profile, The reflected waves further north of this bending point are extremely strong, and have 0.5-0.7 sec duration time. Such duration is not modeled by a single low velocity layer as under the southernmost part of the profile, but by a several kilometer thick reflective zone whose top is flat as compared with the geometry of the subducted plate. It is interesting that the LVF events are distributed beneath this reflective zone. The remarkable spatial correspondence between the cluster of LVF events and the reflective zone strongly indicates that dehydrated fluids ascending from the oceanic lithosphere are trapped in the vicinity of the top of

the oceanic crust to form strong reflective zone. This fluid movement is considered to be a responsible factor for generating VLF events.