Detailed structures of the subducted Philippine Sea plate and the overriding SW Japan arc –New findings from reinterpretation of previously obtained seismic data with modern processing techniques-

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In the last two decades, a number of seismic expeditions with use of controlled seismic sources were undertaken in and around the Japanese islands. These data sets, however, were sometimes not fully interpreted because of technical limitation of processing at the times of their acquisition. The present paper tries to find out new structural information directly related with the plate subduction beneath the Kii peninsula, SW Japan, by applying recent modern processing and interpretation methods to relatively old seismic data collected in 2004 and 2006.

The Kii peninsula, the southern part of the SW Japan arc, is located in the eastern part of the well-known seismogenic zone along the Nankai trough associated with the subduction of the Philippine Sea (PHS) plate. The plate boundary beneath this peninsula is in the stable or conditionally stable regime except for its southernmost tip (the northwestern end of the rupture area at the 1944 Tonankai earthquake (M7.9)). The Kii peninsula itself is geologically divided into two part by the E-W trending Median Tectonic Line (MTL), and well recorded the deformation and evolution processes dominated by the plate subduction. South of the MTL, Cretaceous-Jurassic accretionary complexes are exposed, whose northernmost unit consists of high P-T metamorphic rocks (the Sanbagawa metamorphic belt (SMB)). The region north of the MTL, on the other hand, is occupied by older accretionary complexes, partly suffered from the Cretaceous magmatic intrusions.

We reanalyzed the previous reflection/wide-angle reflection data mentioned above, using modern processing and interpretation techniques including CRS (Common Reflection Surface)/MDRS (Multi-Dip Reflection Surfaces) stacking and seismic interferometry (SI). For the 2006 data, careful wide-angle reflection analysis was undertaken to estimate heterogeneous velocity structure around the subducted plate boundary.

Our analysis delineated clear geometry of the PHS plate. Actually, plate boundary is traced down to much deeper depth of 30-40 km as compared with the case of the conventional reflection processing. From the 2006 seismic data, which were collected in the eastern part of the peninsula, the integrated refraction/wide-angle reflection analysis reveals significant regional change in reflectivity along the downgoing plate interface. In the southern part of the peninsula, just north of the northwestern end of rupture zone of the Tonankai earthquake, reflection occurs in a very thin (<1 km) low velocity (Vp=3.5-5 km/s) layer at the top of the PHS plate. In the northern part, on the other hand, reflectors are distributed in diffused manner with a thickness of 3-5 km, around which low frequency earthquakes are occurring. Such structural feature is probably dominated by dehydrated fluid from the subducted oceanic curst/mantle.

For the overriding SW Japan arc, we succeeded in getting very clear image of the MTL from the 2006 seismic data. Actually, it extends almost to the plate boundary with a 5-10 km thick reflection band. Amplitude analysis indicates that the top of the MTL has a velocity contrast of 0.5-1 km/s to a depth of 15-20 km. In the middle part of the Kii Peninsula, the reflection image of MTL from the 2004 data shows the similar features as those in the eastern part of the peninsula. The seismic image using SI suggests another norward dipping events south of the MTL which may correspond to the boundary of the accretionary complexes overriding the PHS plate.

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