Imaging subduction structure beneath the eastern part of Kii Peninsula, SW Japan, using an earthquake reflection method

*Eiji Kurashimo[1], Takashi Iidaka[1], Noriko Tsumura[2], Takaya Iwasaki[1]

1. Earthquake Research Institute, the University of Tokyo, 2. Chiba University

The Nankai trough region, where the Philippine Sea Plate (PHS) subducts beneath SW Japan arc, is a well-known seismogenic zone of interplate earthquakes. The most recent great earthquakes occurred in 1944 (Tonankai Earthquake, M=7.9) and 1946 (Nankai Earthquake, M=8.0). In recent years, various slip motions with a different time scale have been recognized at or near the updip and downdip limits of seismogenic zone [e.g., Obara, 2002; Ito and Obara, 2006]. Revealing structural factors that control the fault slip behavior is important to understand the earthquake rupture dynamics. Seismic reflection characteristics and seismic velocity variations can provide important information on the heterogeneous structure around plate interface. Recent seismic experiments reveal the relation between the crustal structure and the fault slip behavior. However, little is known about the deeper part of the plate boundary, especially the down-dip side of the seismogenic zone. In 2015, seismic array observation was conducted to obtain the subduction structure beneath the eastern part of the Kii Peninsula [Kurashimo et al., 2016]. Ninety 3-component portable seismographs were installed on a 90-km-long line nearly parallel to the direction of the subduction of the PHS. Waveforms were continuously recorded during a six-month period. During the seismic array observation, Japan Meteorological Agency determined 45 events within 10 km of our survey line. Prominent late arrivals, probably reflected waves from the deeper part of the crust can be recognized on the record sections. Earthquake data is useful to obtain a deep image. So, in order to clarify the spatial distribution of the reflectors, we applied the reflection method to the earthquake data. We used horizontal-component seismograms, because high amplitude S-wave reflection can be recognized on the record sections. Conventional common mid-point processing cannot be applied to earthquake data because the reflection point does not lie at the mid-point between source and receiver, so, we applied the Common Reflection Point (CRP) transformation [e.g., Quiros et al., 2016] to the earthquake data set using a tomography-derived 3D S-wave velocity model [Kurashimo et al., 2016]. Reflection points and their relevant travel-time from earthquake to receiver were calculated using a 3D finite difference travel-time algorithm [Hole and Zelt, 1995]. Before applying the CRP transformation, the waveform data were filtered by a band-pass filter (1 -8 Hz). After applying the CRP transformation and the stacking process, we applied a post-stack migration technique. The migrated shear wave reflection image shows that the northward dipping reflective zone interpreted to be the upper boundary of the PHS can be recognized at a depth range of about 25 -30 km. The top of the low-frequency earthquakes (LFEs) occurrence zone well corresponds to the high amplitude S-wave reflective zone. LFEs are also located in and around the low Vp and high Vp/Vs zone [Kurashimo et al., 2016]. These results suggest the occurrence of the LFEs may be associated with fluids.

Keywords: Philippine Sea plate, earthquake reflection method, Low-frequency earthquake

