# Retrieving reflection waves from the Philippine Sea plate boundary using seismic interferometry with the PKIKP phases

*Toshiki Watanabe[1], Naoki Sogawa[1]

1. Graduate School of Environmental Studies, Nagoya University

In the Chugoku-Shikoku region of southwestern Japan, associated with the subducting Philippine Sea plate, locked, transitional and steady-slip zones are distributed according to the depth (Obara and Kato, 2016). Various seismic phenomena occurs including slow-slips and deep low-frequency tremors. They are thought to be due to the nature and state of the plate interface. Seismic surveys have suggested a relationship between the state of the plate interface and the amplitude of reflected seismic waves (e.g. Fujie et al., 2002, Sato et al., 2006). Laboratory experiments showed a relationship between the frictional intensity at the interface and the amplitude of the transmitted wave (Nagata et al., 2008). In this study, the reflection waves at the plate boundary were retrieved from the seismic waveform observed at the stationary seismic stations. Then, the spatial distribution of the reflection amplitude on the plate boundary was estimated.

We used seismic interferometry (autocorrelation analysis) to retrieve the reflected waves at the plate boundary from the natural seismic waves. In a one-dimensional wave field, the autocorrelation of a seismic record observed at a single station on surface is equal to the reflected wave response from the virtual source at the station (Claerbout, 1968). In the Chugoku and Shikoku regions, since there are few deep earthquakes below the plate boundary, we used the PKIKP phase which is regarded as a plane wave with a near-vertical incident angle (Ruigrok and Wapenaar, 2012).

From the seismic records of 119 Hi-net stations and 10 F-net stations in the study area observed from 2006 to 2018, 240 earthquakes were found under the condition that the epicenter distance was 140 to 180 (deg) and that the magnitude (Mw) was 6 or more. Among them, 16 events records with high S/N without phases such as PKP and PKiKP were used for analysis. After applying a bandpass filter of 0.1 to 4.0 Hz, the autocorrelation was calculated. The deconvolution was performed to remove the influence of the incident waveform. Then the autocorrelations were stacked for each station. Inelastic attenuation was corrected using the Q-value after Salah and Zhao (2003). Depth conversion was performed using the velocity structure using JMA2001 and the 3-D seismic velocity structure (Matsubara et al., 2019).

In the reflection depth profile, laterally-continuous reflected waves with positive amplitude were recognized which correspond to the Moho (Shiomi et al., 2006) and the upper limit of the hypocenter distribution in the slab. We interpreted them as a oceanic Moho. In the Chugoku region, positive amplitudes corresponding to the land Moho (Shiomi et al., 2006) were also observed. Although not as clear as the oceanic Moho, negative amplitudes were observed that may corresponded to the Philippine Sea plate boundary estimated by Hirose et al. (2008) and Iwasaki et al. (2015) The spatial distribution of the amplitude of the reflected wave, which was interpreted as the plate boundary, shows variation at the same depth. The amplitude decreased with increasing the depth of the plate boundary. There did not seem no clear tendency that the reflected wave amplitude increased in the transition and steady-slip zone compared to the locked zone. In the tremor region, the reflected wave amplitude was large in western Shikoku.

 

Keywords: Plate boundary, reflected wave

 