

Seismic interferometry imaging of seismograms observed in the Fujikawa-kako fault zone - ISTL seismic reflection survey

Yusuke Kawasaki^{1*}, Toshiki Watanabe¹, Tanio Ito², Ken-ichi Kano³, Yasutaka Ikeda⁴, Noriko Tsumura⁵, Kenji Nozaki⁵, Shintaro Abe⁶, Tetsuya Takeda⁷, Susumu Abe⁸, Akira Fujiwara⁸, Kazuya Shiraishi⁸

¹Nagoya University, ²Teikyo Heisei University, ³Shizuoka University, ⁴The University of Tokyo, ⁵Chiba University, ⁶AIST, ⁷NIED, ⁸JGI, Inc.

Seismic interferometry synthesizes the pseudo seismic response between receivers by cross-correlating records observed at the receivers, which corresponds to the seismic response observed at one receiver from the other receiver as a seismic source. The method enables us to obtain a subsurface structure using seismic records without using artificial sources.

The Fujikawa-kako fault system - Itoigawa-Shizuoka Tectonic line (ISTL) seismic reflection survey was conducted from April 2 to April 15, 2012. The survey line crosses the Fujikawa-kako fault zone, the Minobu fault system, and the ISTL. This survey aimed to elucidate the sedimentary structure of the lower Fujikawa River region, the deep structure of the fault system and the Philippine Sea Plate.

In this study, we applied the auto-correlation analysis and the cross-correlation analysis of seismic interferometry to the seismogram of natural earthquakes observed by the survey line. We compared the results obtained by seismic interferometry with the seismic reflection profile and evaluated the validity and the applicability of the methods.

We selected 24 earthquake records among the earthquake records observed during the reflection survey. The records of 8 artificial sources used for the wide-angle reflection survey were also used in this analysis. We extracted the P-wave of natural earthquake from the first arrival to S-wave arrival. For the analysis of the artificial source records, a time windows of 10 seconds from first arrival was applied. We applied the band pass filter between 4 and 16 Hz, and then, manually removed the traces with indistinct first arrival of P-wave before correlating each seismic record. Moreover, we applied the static correction, a technique often used in the analysis of a land reflection survey, to the reflection record to remove the effect of receiver elevation and shallow layers.

The result of the interferometry analysis using natural earthquakes and that using artificial sources shows good agreement. The profile is consistent with that of the seismic reflection survey. This indicated that seismic interferometry works as an effective exploration method. However, the deep structure, such as the plate boundary, was not well imaged in the profile. One of the reason is that the number of earthquake records used in this study was insufficient due to the short observation period.

Keywords: seismic interferometry, seismic reflection survey, subsurface structure, Fujikawa-kako fault zone, Itoigawa-Shizuoka tectonic line