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The Particular Phase in the Seismic Wave Propagating along Trench

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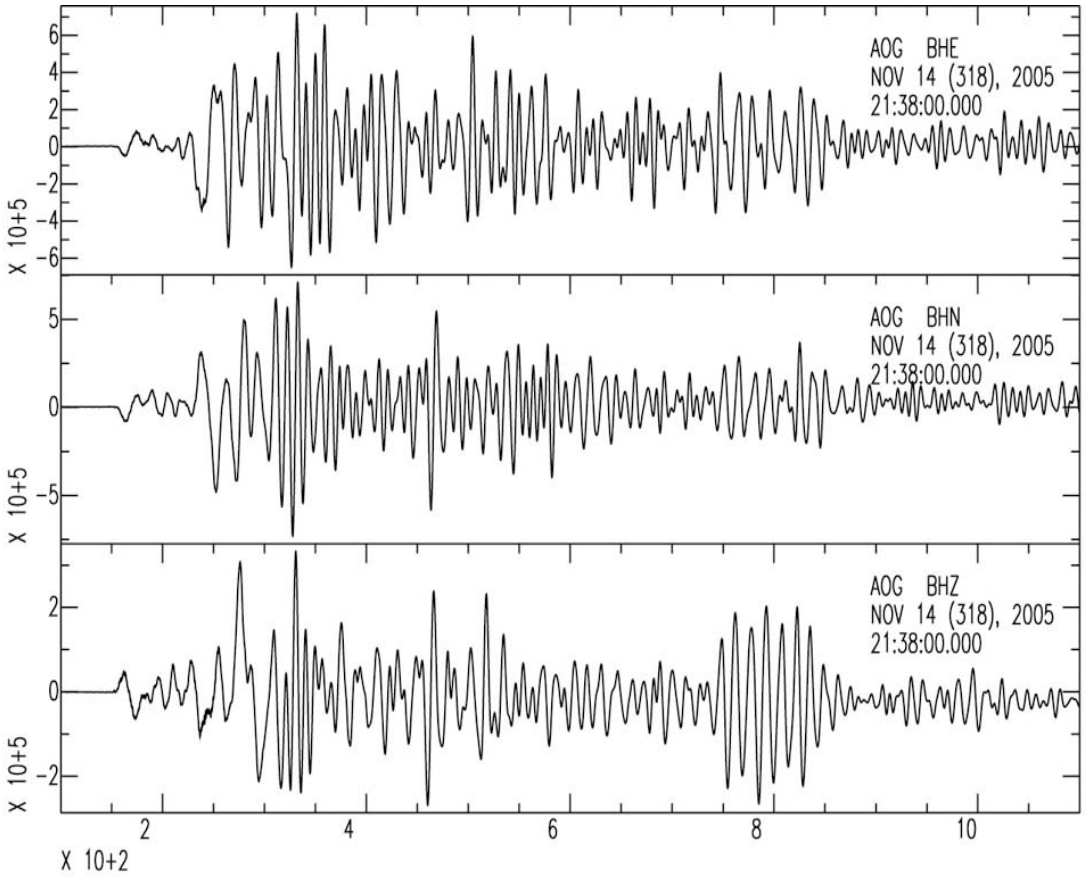

Fig. 1. Displacement waveform observed at F-net AOGF during the outer-rise earthquake at off Sanriku (Mw 7.0, 14, Nov., 2004).

Introduction

It has been revealed that the seismic wave propagating seafloor can be affected obviously by particular structure including seawater, different from that on land. For example, Hatayama (2002) showed that the seawater layer affects on the amplitude of Rayleigh wave form the results of simulation using 2D boundary element method. Yamada and Iwata (2005) and Furumura et al. (2008) simulated the long-period ground motions which observed during the 2004 off the Kii peninsula earthquakes (Mw 7.2 and Mw 7.4) by means of 3D finite difference method. They showed that the sedimentary wedge structure along the Nankai trough amplifies and elongates long-period ground motions. However, it is difficult to find out the obvious evidence from observed records because the locations of stations and hypocenters are limited around subduction zone. In such condition, we found out the particular phase which seems to be affected by seafloor structure among the records observed during outer-rise earthquake.

The Particular Phase

Fig. 1 shows the broadband waveforms observed at the F-net station AOGF located at Izu islands during the outer-rise earthquake (Mw 7.0) at off Sanriku, east side of Japan Trench, 14, November, 2005. There is a large amplitude phase around 500 s after the initial phase of S-wave, far delayed form the arrival of surface waves. The similar phase were also found at the F-net HJOF, the neighbor of AOGF, but smaller than that of AOGF. During the other outer-rise earthquake (off Sanriku, Mw 4.9, 1, November 2005), the similar phase was also observed at AOGF. On the other hand, such phase did not appear on the waveforms recorded during earthquakes at the west side of Japan Trench, such as the 2005 off Miyagi Earthquake (Mw 7.2). Because they appear on the records derived from the limited combination of station and event, it can be assumed that the particular phase would be due to the propagation path along Japan Trench.

It was also shown that the particle motion of the particular phase is deviated by around 20 degrees to east from the great circle path, compared to that of direct wave. Because of the large amplitude of vertical component, the particular phase is considered to be Rayleigh wave. Therefore, the deviation angle of the phase means the arrival direction of Rayleigh wave. In the direction from AOGF, there is the triple junction of Japan Trench, Izu-Bonin Trench and Sagami Trough. Around the triple junction, the water depth is deeper, and wider compared to that of the Japan Trench. Because of such form of seafloor, the sedimentary wedge also could be thicker, similar to the seawater. It can be considered that the special structure around the triple junction including the layer of seawater would induce the particular phase which observed at AOGF.

Simulation

To confirm the hypothesis, it would be needed to perform the detailed simulation of wave propagation using 3D structure including seawater and sedimentary wedge, by means of finite difference method. After the simulation, the effect on the seismic wave caused by seafloor structure would be confirmed in terms of seismic observation. Furthermore, we would evaluate the effect on the seismic wave caused by seafloor structure based on the waveform synthesized using the structure modified based on the observed record.

Acknowledgement

We used the continuous seismic data recorded by F-net, NIED.

Keywords: Sedimentary Wedge, Effect of Seawater on Seismic Wave, Triple Junction, Long-Period Ground Motion