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フィリピン海プレートの短波長不均質とガイド波
Small-scale heterogeneities in the Philippine Sea plate and the guided waves

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The oceanic lithosphere is an extremely efficient waveguide for high-frequency seismic wave. The guided wave, Po/So phases propagate within the oceanic lithosphere and are commonly observed on ocean bottom seismometer records in the distance range of from 5 to 30 degrees.

The Philippine Sea is one of the marginal seas of the Pacific Ocean and contains very complicated tectonic settings. It is fundamentally divided into two regions bounded by the Kyushu-Palau Ridge. It is thought that these two regions were formed in different episodes of back-arc spreading and that western part is older than eastern part (e.g. Seno and Maruyama, 1984). Such complicated tectonic settings are expected to affect the structure of the oceanic lithosphere and propagation of the guided waves.

Seismological observations using Broad-Band Ocean Bottom Seismometers (BBOBSs) was conducted in the Philippine Sea from 2005 to 2008. In the BBOBS data, high-quality Po and So waveforms from earthquakes in subducting Philippine Sea plate were recorded. Prominent features of Po and So phases are summarized as follows. (1) The frequency content of Po and So waves is up to 20 Hz, which is much higher than that of direct P and S waves. The frequency content of So waves is slightly higher than that of Po waves. (2) The travel time interval between the direct P and Po phases varies with the event depth (and the epicentral distance). (3) The Po and So phases gradually build up and decay with extremely long durations (1-2 mins). The durations of the Po phase are longer than that of the So phase, and extend into the onset of the So phase. These features indicate that the Po and So phases propagate as guided waves in the oceanic lithosphere with intense scattering, whereas the P and S waves travel directly from the sources. (4) The Po/So phase propagate much effectively in western part than eastern part of the Philippine Sea.

In order to investigate the nature of the structure of the oceanic lithosphere and the guided waves, we performed numerical FDM simulations of two-dimensional (2-D) seismic wave propagation in a realistic oceanic lithosphere model. Applying the method described by Furumura and Kennett [2005; 2008], we conducted parallel FDM modeling of high-frequency (fmax=5 Hz) seismic wave propagation in heterogeneous structure in order to explain observed feature of Po/So phases. We will demonstrate that the low-frequency direct P and S waves propagate in the asthenosphere and that the following large-amplitude, high-frequency, and long-duration Po and So waves are developed by multiple forward scattering of P and S waves due to laterally elongated heterogeneities in both the subducting and horizontal parts of the oceanic lithosphere.

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