Global source locations of P-wave microseisms using Hi-net data from 2005 to 2011

*Kiwamu Nishida[1], Ryota Takagi[2]

1. Earthquake Research Institute, University of Tokyo, 2. Tohoku University

Observations of microseisms date back to the early 1900s [Wiechert 1904]. Although observations of microseisms were firmly established, the excitation mechanisms are still in debate. According to the typical frequency, they can be categorized as primary microseisms (0.02-0.1 Hz), and secondary microseisms (0.1-1 Hz). The former frequency range corresponds to that of ocean swell itself, whereas the latter corresponds to double the frequency of ocean swell. Excitation of primary microseisms can be attributed to linear forcing by ocean swell through the topography in shallow depth, whereas that of secondary microseisms can be attributed to non-linear forcing by standing ocean swell at the sea surface in both pelagic and coastal regions.

The source distribution of secondary microseisms is crucial for understanding the excitation mechanism of secondary microseisms. A back projection method is feasible for locating secondary microseisms. However, complex wave propagations of surface waves caused by strong shallow, lateral heterogeneities prevent from the precise location of the sources. In contrast, body wave microseisms are less scattered than the surface-wave microseisms. Although the amplitudes of body wave microseisms are smaller than surface wave amplitudes, recent developments in source location based on body-wave microseisms enable us to estimate precise locations of forcing and the amplitudes quantitatively [e.g. Nishida and Takagi, 2016].

In this study, we made a catalogue of P-wave microseisms by array analysis using the high-sensitive seismograph network (Hi-net) operated by NIED from 2005 to 2011. We analyzed vertical-component velocity-meters with a natural frequency of 1 Hz at 202 stations in Chugoku district. The instrumental response was deconvolved by using an inverse filtering technique [Maeda et al. 2011] after reduction of common logger noise [Takagi et al. 2015]. The records were divided into segments of 1024 s. After exclusion of segments which include transients, the frequency-slowness spectra were calculated. The spectra at 0.15 Hz show that clear teleseismic P-wave microseisms on seismically quiet days when local swell activities were calm. The local maxima of the spectra were picked up. The centroids of the sources were located by backprojecting the corresponding slowness. The source locations show clear seasonal variations. In winter months, they were located in the northwestern Pacific, and in the summer months, they were located in the southern Indian ocean. Through the years, centroids stayed in the north Atlantic ocean, although they show a weaker seasonal variation with the maximum in winter. The locations can be explained by an ocean action model (WAVEWATCKIII: Ardhuin et al. 2011). In further studies, we will calculate the equivalent vertical single force for quantitative discussions.

Keywords: microseisms, ocean swell, P wave

