Geophysical Research Abstracts
Vol. 13, EGU2011-5629-1, 2011
EGU General Assembly 2011

Detecting Subsurface Reflections in the Kinki District, Southwestern Japan, Using Ambient Seismic Noise

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In most studies of ambient noise seismology, surface waves retrieved from cross-correlation functions (CCF) of the ambient noise are used to study crustal structure and related fields. However, body wave part retrieved in CCF's has rarely been reported (e.g. Zhan et al., 2010, GJI).

In this paper, we demonstrate to detect several subsurface reflectors in Kinki district, southwestern Japan, using ambient seismic noise. In this area, several subsurface reflectors are reported in previous studies. One example is a mid-crust reflector in Tamba area (near Osaka and Kyoto, e.g. Katao, 1993). We computed the auto/cross-correlation functions (ACF/CCF) of continuous short period UD components seismograms obtained from Hinet (NIED), JMA (Japan Meteorological Agency), and DPRI (Kyoto Univ.) seismic networks. We divided the seismic record into 1 hour segments and applied 'running absolute mean normalization' (Bensen et al., 2007, GJI) and band-pass filtering (0.5 – 1.0 Hz). Then we calculated ACFs/CCFs and stacked them for at least 15 months long. At borehole stations whose depths are more than 1000 m, clear 'exotic' phases other than surface waves are observed.

We assumed a 1D model based on the previous result of seismic exploration survey in Kinki district (Hirose and Ito, 2007) and calculated theoretical travel times from Moho and other several crustal discontinuities as well as group velocity of the Rayleigh waves. Travel times of the observed 'exotic' phases are generally explained as signals from subsurface reflectors. At the 2000 m borehole, Moho reflection (PmP) is well identified within 100 km distance as well as other crustal reflections. At station pairs of which distance ranges are greater than 100 km, travel time of 1-st higher mode Rayleigh wave well explains the travel time of the observed exotic phase, however, the amplitude of the observed phase is much larger than that expected from theoretical calculation, which requires further investigation to identify the origin of the phase.