A trial for reflection structure imaging beneath Japan Islands using cross-correlation analysis of teleseismic records

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Seismic interferometry reconstructs a Green's function (a shot record) from one receiver (seismic station) as a source to another receiver using the cross-correlation of the seismic records observed at two receivers. In order to obtain a subsurface image, seismic reflection survey requires lots of artificial seismic sources. Cross-correlation analysis, however, has a possibility to obtain equivalent subsurface images using natural earthquakes, for example, swarms, aftershocks, teleseismics and noises, as well as a small number of artificial sources as energy sources.

A dense high-sensitivity seismograph network (Hi-net) is spread over Japan Islands. Using the Hi-net data, seismic structure such as the Moho and the plate boundary can be obtained in three-dimensions. In this study, we applied the cross-correlation analysis and prestack depth migration to the teleseismic records obtained by Hi-net in order to detect seismic reflection structures beneath Japan Islands. The UD components of 58 teleseismic events observed from April 2003 to August 2004 were used. Seismic records of 600s including first arrival were bandpass filtered (0.4 - 1.2 Hz). Any pair of seismograms observed two stations was cross-correlated and formed a shot record equivalent. After the prestack 3-D Kirchhoff depth migration, a 3-D reflector image was obtained.

A 3-D imaging was performed in Hokkaido and Tokai area. A 2-D line from Kanto to Kyushu was also imaged. The analysis is still underway. So far, the reflection images show some dipping layer-like structures that may correspond to the plate boundary and the Moho. However, the images are obscure and has insufficient resolution and accuracy. One of the reasons may attribute to the phases generated around the hypocenter that can form spurious reflectors when cross-correlated. Further improvements and investigations are required, such as the use of seismograms as many as possible to reduce the spurious reflectors.