Array analysis in subsurface monitoring using seismic ACROSS: (1) Frequency dependence and spatial correlation

Hirokazu Itoh[1]; # Yoko Hasada[2]; Naoyuki Fujii[3]; Toshiki Watanabe[4]; Mineo Kumazawa[3]; Takahiro Kunitomo[1]

[1] Shizuoka Univ.; [2] RSVD, Nagoya Univ.; [3] Geosci., Shizuoka Univ.; [4] RCSV, Nagoya Univ.

ACROSS (Accurately Controlled and Routinely Operated Signal System) is effective in monitoring state changes of Earth's interior. The seismic array observation of the ACROSS signal enables us to estimate the incident directions of the wave arrivals in the transfer function data.

Hasada et al. (2006) suggested that the transfer function acquired by seismic ACROSS has complicated frequency dependence probably caused by the local heterogeneity. In this study, we carried out the frequency-dependent array analysis of the data acquired by two seismic ACROSS observations and discuss the influences of the sensor distribution and the signal frequencies upon the transfer functions.

The first data set was acquired by the seismic ACROSS transmitter at Toki, Gifu prefecture and the seismometer array at Horai, Aichi prefecture. Soma et al. (2007) have detected the possible reflected wave from the plate boundary through the semblance analysis of the data. We applied frequency-segmented semblance analysis to the same data, and found that the incident directions did not show very significant frequency dependence. The semblance values of S wave group was relatively low in general, indicating that the local heterogeneity disturbed the S wave fields with short wavelengths.

As the second data set, we analyzed the transfer functions acquired by and the ACROSS transmitter at Mori, Shizuoka prefecture and the seismic array at Shizuoka airport, 20 km away from the transmitter. By the preliminary analysis, the P wave arrival was not clear and the S wave arrival was significantly later than expected. The result of semblance analysis however shows low frequency dependence of the incident directions, similarly to the first data set.

For the first data set, the sensor interval of the array is comparable or larger than the wavelength of the seismic wave from the transmitter, resulting in the low spatial correlation of observed data. On the other hands, the sensor interval of the second array is smaller than the wavelength and it is the higher spatial correlation is expected. Though the actual heterogeneous structure around the array affects the spatial correlation and the frequency dependence, it is confirmed that careful planning of the array design with the signal frequencies considered is important for the monitoring using seismic ACROSS.