

Review on the development of ACROSS in the past 11 years and prospects towards the next decade

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Eleven years have passed since ACROSS was proposed at the Meeting of Exploration Geophysics in Japan in 1995 as a new geophysical exploration and monitoring method. We review the progress made by ACROSS in both (1) seismology, which aims at detection of potentially disastrous earthquake fields within the Earth's crust and (2) as a geophysical exploration method with higher resolution and better quality compared to contemporary methods. ACROSS technology has been developed to a practical level as far as the data acquisition hardware is concerns, however the system is not yet user-friendly and numerical method have not yet been developed to utilize a full extent the high quality data that has been obtained.

The current level of ACROSS technology is demonstrated by (1) some examples of tensor transfer function between the source and receiver with ~100 km separation and (2) the result of empirical seismic monitoring in the area within a distance of ~100 km from the Tono Mine. The evolution of theoretical backgrounds behind the technology is also reviewed. An emphasis is placed on the importance of signal theory for the active exploration robust against noise. The ACROSS signals designed on this theoretical basis enabled us to acquire the accurate and unbiased data on the transfer function between the source and receiver. The use of such signals is expected to improve the data quality in almost all active methods of geophysical exploration. The transfer function thus obtained is identified as the Green's function for wave propagation within a finite isolated body as a linear dynamic system. The relevant subject is to devise a practical method of numerical correspondence between the transfer function of the observations and the Green's function for theoretical model of the underground structures.

We shall present our prospects on the expected progresses together with our development plans for the next decade: (1) Development targeting a monitoring system for the underground beneath the entire Japanese islands, which has started from the detailed investigation of the Tokai Earthquake field in Shizuoka prefecture, (2) realization of remote monitoring system at Horonobe, Hokkaido for studying the stability of the underground environments in the area within ~10 km and (3) theoretical and computational work to make it possible to utilize the high quality ACROSS data to a full extent for the multi-dimensional analysis of the underground structures and determination of their physical states.