

EM ACROSS experiment at Kusatsu-Shirane volcano

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The Accurately Controlled, Routinely Operated, Signal System (ACROSS) is a system which combines at last one controlled source transmitter with one signal receiver for investigating the subterranean space. The accurately controlled signal lets us be able to discriminate that from other background signal in data analysis. The routinely operated signal provides a robust anti-noise ability while stacking the recorded signal in processing. The EM-ACROSS is one kind of the above-mentioned system that using electromagnetic wave for the transmitted signal.

In this study, we designed a signal transmitter for injecting the current into two pairs of the grounded electrode arrays. The signal is a superposition of harmonics which generated with arbitrary phase shift and same amplitude. The transmitter is continuously synchronized with a 10M Hz GPS signal for ensuring the accurate control. A GPS synchronized signal logger is connected with the transmitter for the subsequent signal analysis. We use MTU-5 series magnetotelluric receiver from Phoenix-Geophysics to be our signal receiver. At Kusatsu-Shirane volcano, we set 9 sites for MT stations which are 3.6 km to 5.6 km far from the transmitter. Each MT receiver records at last 10 hours data for the signal from both current dipoles.

The integrality and stability of transmitted signal is confirmed by analyzing the logged data from transmitter. In the processing of received signal analysis, we use stacking method which divides the entire time series into minor frames then stacks each frame in frequency domain after tacking the Fast Fourier' s Transform. This method provides the high signal-to-noise ratio (SNR) while we do a large enough number of stacking, which associate with the data quality, ambient noise level, and the strength of controlled source. We compare different numbers of stacking for the data from same MT station record and confirm that the sufficient stacking is one of the focal point to get high SNR.

The result of received signal analysis presents that the anti-noise ability of EM-ACROSS method is distinguished at higher specific frequencies, particularly in one of our station, which is a very noisy area with continuous and stable anthropogenic noise. Therefore, we are able to consider more location for the MT station with this system while we are planning the investigation. With the EM-ACROSS survey, we can use the value of injected current, electric and magnetic fields from our specific frequencies to calculate the modeling parameters as from conventional MT survey. And this system provides more ability while we aim a subterranean target in noisy area.

Keywords: magnetotelluric, geophysical prospecting, geophysical techniques, controlled-source electromagnetic methods, transmitters, received signals