

## Observation of DC Electric Field Radiated prior to Large Earthquakes

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According to results of increase of ionosphere electrons density which was formed prior to large earthquakes, it has become that the density increase might be caused by DC electric field generated prior to the earthquake. On the other hand, we found, in the laboratory simulation experiment on electromagnetic radiation from earth's crust, that a fluctuation of DC electric field was detected prior to strong impact by fracture of a glass ball, after loading heavy stress to the glass ball between two granite pillars. In order to confirm the DC electric field detected prior to large earthquakes, I began to observe DC electric field in a mountain side of Kyoto where electromagnetic environment is extremely quiet.

I used linear dipole antennas as a sensor system of DC electric field. For cancelling out the background electric field formed against the ground and for shortcutting AC electric components of electromagnetic noise, a new electric circuit composed of a resistance and a capacitance connected in parallel was connected between two dipole antenna elements. Since electric voltages at two connecting points between the electric circuit and each antenna element were led to a differential amplifier, the common mode of the background electric noise around the observation system can be cancelled out, and many AC electric components of electromagnetic noise can be shortcut. Then DC electric field only can be detected. Two sets of dipole antenna of 5 m tip-to-tip were installed in east-west and north-south directions at 4 m height, by which polarizations of horizontal electric field can be obtained. Output voltage from pre-amplifiers (700 times of input voltage) are captured as digital data by a personal computer via AD converter with a sampling frequency of 1 Hz. Since one data set is consist of 4096 points, we can see a time variation of DC electric field of 68 min duration.

The observation of DC electric field was started on Feb 5, 2016. Daily variation of DC electric field is as follows: electric field in nighttime was very quiet although there appeared large electric fluctuations in daytime. Therefore, the nighttime is suitable for the present observation of DC electric field.

At 08:28:30.9 Feb 9, 2016, we had an earthquake of M2.1 at 12 km depth of 18.5 km west of our electromagnetic observation site. A long time fluctuation of 25 min period of DC electric field was detected 35 min prior to the earthquake. Large amplitude electric noise of the shorter fluctuation (~8 second period) were also superposed on the large fluctuation. The long time fluctuation showed a similar form obtained in the laboratory experiment. Since the noise components of shorter fluctuation showed elliptic polarizations, they might be radiated out of the ground surface. Hereafter, for clarifying the validity of generation of DC electric field prior to large earthquakes, we need to obtain a quantitative result of these DC electric fluctuations.

Keywords: DC Electric Field related to Earthquakes, Observation of Electric Field