S049-009 Room: 201B Time: May 26 16:00-16:15

Prediction of Seismic Ground Motion by Electric Fields Occurring Simultaneously with the Earthquake

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[1] None

Since April of 2002, we have observed electric fields at Hasaki Observation Site of NIED (National Research Institute for Earth Science and Disaster Prevention), using the electrodes which are composed of 805m steel pipe inserted into a vertical hole and copper wire surrounding the pipe. The recorder is Sanei-8D23A-H, whose speed is 2mm/sec, sensitivity is 1mV/cm, and time accuracy is 0.05 sec.

The frequency bands were changed in Dec. of 2002, from 0 - 0.7 Hz, 0.01 - 0.7 Hz and 1 - 9 kHz to 0 - 1.1 Hz, 0.01 - 1.1 Hz, 0.23 - 30 Hz and 1 - 9 kHz.

As of 8 Feb. 2003, we have detected the electric fields, which accompany the earthquake, three times, on 14 June 2002, 16 Oct. 2002 and 9 Jan. 2003. The magnitude of the earthquakes was 4.9, 4.8 and 4.7, the maximum acceleration of P wave front was about 6.8 gals on 14 June 2002 and 3.9 gals on 16 Oct. 2002, and the hypocentral distances were less than 100 km. During this period, there was no earthquake whose maximum acceleration of P wave front was larger than 3.9 gals, except above earthquakes. On 9 Jan. 2003, no seismic data was obtained at the observation site.

The observed fields accompanying the earthquake show that

(1) The electric fields start to be observed at the origin time, when the earthquake starts, increase until P wave arrives at observing site, and attain the maximal when P wave arrives at the site.

(2) No electric impulse is observed when P wave arrives at the site.

(3) The field intensity decreases from the time when P wave arrives at the site, and approaches to zero before S wave arrives.

(4) S wave generates a strong electric impulse just after S wave arrives at the site, though S wave generates no fields until S wave arrives at the site.

The curve of electric field intensity, which was observed before P wave arrived, agrees with the curve where the fields are induced by the electric charge which is distributed equally on the surface of P wave front. By the way, field intensity is inversely proportional to square of distance between the charge and observing site, where distance is relatively short, and magnitude is usually defined by common logarithm of maximum speed of ground motion. The charge, flow potential, electromotive force, or some other mechanisms, which induce electric fields, will be proportional to the speed. So, the field intensity will be proportional to Mth power of 10. As a result, the induced field intensity might be expressed approximately by the following forma, for example,

E(t) = a 10 exp(M)/{D - r(t)} exp(2)

where t: lapse from origin time

E(t): Field intensity at time t

r(t): Distance between hypocenter and P wave front at time t

= t x (Speed of P wave)

a: positive constant which depends on observing system of fields and propagation path

M: magnitude

D: hypocentral distance

Above formula shows that when we observe two or more values of electric field intensity, then we can know both of the hypocentral distance, D, and magnitude, M. This means that in a few seconds from the onset of an earthquake we can determine the source and magnitude, and predict the ground motion. This prediction is effective in stopping nuclear reactors in power plants, cars on high ways or railroads, and airplanes on airports, for example, before the start of strong ground motion. Even if there is only one second between stopping of the reactor and arrival of P wave, the emergency stopping of reactor can prevent the catastrophic disaster.

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