

Detection of ultra-micro cracks associated with the great Tohoku Earthquake by means of an electromagnetic means

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We detected the pulse like ULF, ELF band electric variations associated with the great Tohoku Earthquake on March 11, 2011. The phenomena started to increase on 7th March after very calm situation attained peak activity on 9th, decreased on 10th, recovered considerably in the morning on 11th till the very moment of the huge earthquake. The signal has been very familiar to us from the observation of the ULF band vitiation at the time of small volcanic activity at the Izu-Oshima in 1992. The waveform has very peculiar form as the time evolution of the geyser. The signals have been observed in almost all volcanic eruption activities and seismic swarm as in around Mt. Hodaka in 1998, Mt. Nikko-Shirane, the Miyake Island, and Niigata earthquake. And it is confirmed that the ULF type anomalies are closely related with the crustal activity occurring in the preparatory stage of seismic swarms and volcanic activity. The waveform is similar to the time evolution of the geyser (Geyser-type ULF variation: GUV). The pre-shock, main-shock and aftershock events were rarely accompanied the signal. The phenomena have been known to be induced by the electro-kinetic effect through confined water rapid flow into the small cracks in the crust.

We devised a new detection system having higher dynamic ranges in the frequency and signal strength. And the field observation started on 3, March 2011 at Hasaki (now Kamisu). We found that there are two kind of anomalous signals associated with the Earthquake; one is the very GUV and the other is the higher frequency signal so-called the Uni-corm type ULF variation (UUV). GUV has pulse width of 0.5-30minutes and strength of some 10 times of the variation induced by the earth-ocean tide effect. UUV has pulse width of 10ms and strength of one-tenth of the tidal effect. The strength of both signals maintained their magnitude in the period of the event occurrence.

The number of UUV evolved in a similar way as the pre-shocks and acoustic emissions in the preparatory stage of main fault rupture and rock fracture experiment. On the other hand, GUV has very scare activity before the event, and occurred dominantly after the event. We can infer that the UUV can be used to infer the occurrence time of the main shock before several days.

The observation site is in the corner of the south-eastern end of the huge rupture area of 500km by 200km. The GPS data and the seismic inversion data show that the rupture extended to the area near Hasaki. Based on these evidences we can infer that the ultra-micro crack has been induced even in the edge of the future rupture zone without limited to the asperity zone of off Miyagi-ken of some 45m slip. The hypothesis is far from the ordinary idea of the rupture model. It is the first finding of such phenomena of very small strength which can be detected only by means of very low noise instrument as the borehole antenna system as ours.

We dare extend our inference by suggesting that we can estimate possible magnitude from the estimation of area of the zone of the UUV occurrence by using dense network of the observation system.

Keywords: earthquake precursor, imminent prediction, electric phenomena, ULF band pulse

