

Excitation mechanism and detection of electromagnetic pulses prior to earthquakes

TSUTSUI, Minoru^{1*}

¹Kyoto Sangyo University

We have been observing electromagnetic (EM) pulses generated by earthquake, and recently clarified behaviors of EM waves excited by seismic waves, in which EM pulses can be easily excited due to piezo-electric effect in the earth crust by vibrations of seismic S-waves [1]. On the other hand, we could not detect EM pulse at the rupture time of earthquake. Furthermore, even in laboratory experiment, we could not confirm intense EM noise excitation in frequency ranges of MHz-kHz. Therefore we have concluded that EM pulse cannot be generated in the situations of cracking of earth crusts.

In order to clarify behaviors of EM pulses which would be excited prior to earthquakes. We speculated a generation mechanism of EM pulse in the earth that a kind of resonance in the earth crust by the vibrations of the seismic P-wave propagation in it is important. So we conducted a laboratory experiment in order to inspect EM radiation from crusts. The experimental setup consists of ranging two granite pillars of 10 cm x 10 cm in cross section and 50 cm in length. A small glass ball is pinched between the cross sections of interface of the ranging granite pillars. By increasing external pressure given to the cross sections at the both ends of the ranging pillars, the small glass would be fractured. Then a negative stress impact is given to the interface of the ranging two pillars, and seismic P-waves propagate in the granites. EM pulse excited in the granite pillar due to piezo electric effect can be radiated out. So the stress impacts and following seismic P-wave propagations in a crust with some scale are key point for generating an EM pulse. We will show the experimental result.

Under the speculation based on the experimental result, we have been looking for the observation result. We finally found an EM pulse detected at about 7 hours prior to a rather large earthquake (M3.9), whose waveforms are similar to those obtained in the laboratory experiment.

[1] Minoru Tsutsui, Behaviors of Electromagnetic Waves Directly Excited by Earthquakes, IEEE Geoscience and Remote Sensing Letters, Vol. 11, No. 11, pp. 1961-1965, 2014.

Keywords: observation of electromagnetic pulses, earthquake precursor, excitation mechanism