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A method of monitoring earth-crust stress-changes from identifications of source locations of EM pulses excited in the earth

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We have developed a new method of monitoring earth-crust stress-changes not by detections of kinetic pulses but by detections of electromagnetic (EM) pulses.

Measuring EM waves by sensors installed in a borehole of 100 m in depth, we found earth-origin impulsive EM noises [1]. Then we have been trying to find source locations of earth-origin EM pulses. Since the basic method for finding them is generally to measure a unique arrival direction of an EM wave precisely, we set up a sensor system consisting of horizontally and orthogonally arranged two search coils to obtain its horizontal magnetic field vector **H** and a vertical dipole antenna to detect its electric field vector **E**. From these two vectors, we can determine a propagation direction of the EM wave from Poynting vector (**E** x **H**). In order to apply it to impulsive noises, we developed a method of deriving frequency-dependent arrival directions from amplitudes and phases of each frequency component contained in a pulse, and of determining a unique direction toward the source location of the pulse among the multiple directions.

We detected an earth-origin EM pulse just when an earthquake occurred on Jan. 6, 2004, and found a direction toward the EM pulse source by the analysis method. We also determined its propagation distance toward its source location along the direction, from comparisons of a frequency dispersion curve of the detected EM pulse with those of theoretical propagation model of Tweek atmospherics. Resultantly, we identified that the source location of the EM pulse was in the epicenter region of the earthquake [2].

We have convinced that earth-origin EM pulses are generated through piezo-electric

effect by impulsive stress-changes imposed onto earth-crusts, and have recognized that identifications of source locations of earth-origin EM pulses would be important monitoring method for earth-crust stress-changes. Recently, we have started to establish a network of multiple observation sites equipped by the present system.

References

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