

Triangular measurements for finding sources of EM pulses excited by earthquakes

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In order to elucidate a relation between movements of earth crust and excitations of electromagnetic (EM) pulses in the deep earth, we have accomplished a measurement system to find arrival directions of EM pulses. The sensor system consists of a vertical electric dipole of linear elements of 5 m, and two search coils of 10,000 turns which are assembled horizontally-and-orthogonally with each other. The sensor system was inserted into a bore-hole of 10 cm in diameter and 100 m in depth constructed in the campus of Kyoto Sangyo University. The measurement system can make it possible to detect short (less than 1 msec) EM pulse and can analyze and display frequency-dependent arrival directions.

At 14:49 JST of January 6, 2004, the system detected an intense EM pulse when an earthquake (M5.5) at 34.2 N, 136.7 E and at 35.3 km in depth. The measurement system displayed the arrival direction of the pulse pointing toward the hypocenter of the earthquake. From the analysis of the dispersion characteristics of the EM pulse and the estimation of its propagation distance, we could identify the location of the EM pulse source as at the hypocenter of the earthquake. From this result, we confirmed that the excitations of earth-origin EM pulses would have a strong relation with the movements of the earth crust. For earthquakes occurred during the year, we surveyed arrival directions of EM pulses. Most of them had been detected few days prior to the earthquakes, and the system had pointed toward the earthquake hypocenters.

Based on the importance of clarifying the relation between the detection of earth-origin EM pulses and earthquakes, we have built a project of triangular-measurements of arrival directions of the EM pulses at multiple observation sites equipped by the present system. The second observation cite is the Earthquake Observatory of Nagoya University at Uga-kei, Mie Prefecture, Japan. Since the span between the 1st observation site (Kyoto) and the 2nd one (Uga-kei) is 65 km to east, the triangular measurements by the present system would be effective for determining the source location of EM pulses related to earthquakes occurred in Kii Peninsula and Tou-Nan-Kai Sea.