Geophysical Research Abstracts, Vol. 9, 03514, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-03514

Anomaly behavior of correlation coefficients of ULF geomagnetic disturbances before strong earthquake

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Since 1998 six magnetic stations were located in Japan. These stations are situated at tops of a triangle at Izu and Boso peninsulas at distances 4 - 6 km (magnetic gradientometer). Using 1 Hz sampling data of three pairs of the spaced stations, we can find correlation coefficients of corresponding magnetic components.

The correlation coefficients C_1 were calculated using usual form (1). In (1)x_i and $y_i$are data of corresponding magnetic components from two magnetic stations.

$$C_1 = \frac{\sum x_i y_i}{\sqrt{\sum x_i^2 \sum y_i^2}} \text{ (1)} C_2 = \frac{\sum (x_i+s_i)(y_i+s_i)}{\sqrt{\sum (x_i+s_i)^2 \sum (y_i+s_i)^2}} \text{ (2)}$$

The most prominent effects in the correlation coefficients (increasing C from 0.5-0.6 to 0.7-0.8) was observed in a high frequency range F=0.5-0.1 Hz during 1-2 months before a strong earthquake (M=5.6) at Boso peninsula. Epicenter of the earthquake was situated at $\sim$15 km from the magnetic stations. We suppose that this phenomenon is connected with origination of a new source of the ULF magnetic disturbances located in the Earth's crust in a region of a future earthquake hypocenter. Really, the correlation coefficients C_2in this case have form (2), where s_i is a lithosphere signal. If $s_i << \mathrm{x}_i$ and $s_i << y_i$(lithosphere signal before the earthquake practically absents) $C_2 \approx C_1 < 1$. If $s_i >> \mathrm{x}_i$ and $s_i >> y_i$(lithosphere signal before the earthquake is very powerful) $C_2 \approx 1$. Therefore, we must observe an increasing of the correlation coefficients when the signal from the lithosphere sources increases in time. After the earthquake moment, the coefficients sharply decreased. In a low frequency range, the correlation coefficients are close to one due to considerable exceeding of ionosphere source power over local industrial sources.

Together with anomaly behavior of amplitudes, gradients and phase velocities of the ULF geomagnetic disturbances, the anomaly behavior of the correlation coefficients can be a short-time precursor of strong earthquakes.