Geophysical Research Abstracts, Vol. 9, 10340, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-10340

Extraction of the earthquake precursory signatures from fractal characteristics of ULF emissions

N. Smirnova (1), M. Hayakawa (2), V. Uritsky (1) and A. Mezentsev (1)

(1) St.Petersburg State University, St.Petersburg, Russia, (2) The University of Electro-Communications, Chofu, Tokyo, Japan (nsmir@geo.phys.spbu.ru / Fax: +7-812-4287240)

An extensive series of experimental, theoretical and methodological studies has been conducted to investigate seismic-electromagnetic processes preceding strong earthquakes and their manifestation in nonstationary fractal parameters of ultra low frequency (ULF) electromagnetic fields of the Earth in the frequencies range f=0.001-0.3 Hz. High-resolution records of magnetic components of ULF emissions have been analyzed for two seismically active regions – Guam island (Pacific ocean) and Isu peninsula (Japan) during time intervals including two strong earthquake events. As common precursory changes in ULF emission signals we have found the decrease of spectral exponent β and increase of fractal dimension D of ULF emissions during time intervals preceding both catastrophic seismic events. As a specific peculiarity, we have revealed the difference in starting time of the precursory effects, which we have attributed to the difference of the earthquake focus depths. We have also investigated the dependence of ULF emission fractal parameters on geomagnetic activity level to estimate the contribution of magnetospheric disturbances in the studied lithospheric processes. We found that the growth of geomagnetic activity leads to an increase of β and corresponding reduction in D. These parameters exhibit maximum level of cross-correlations with geomagnetic activity during night hours and minimum level of such correlations during day hours around noon. Therefore, the latter are the most informative for lithospheric studies. Our theoretical investigations involved modeling of critical dynamics of tectonic faults using the approach of self-organized criticality (SOC). We have shown that the relationship between seismic and ULF electromagnetic geophysical processes can be adequately represented by certain classes of SOC models. The results have been summarized in a methodological framework for development

of methods for forecasting catastrophic earthquakes based on anomalous signatures in fractal geophysical fields.

The work has been supported by Russian Program "Intergeophysica".