



Still one evidence of the local ULF lithospheric magnetic activity before Mw=9.0 Tohoku earthquake

Fedor Dudkin (1), Valery Korepanov (1), Denys Dudkin (1), and Yasuo Ogawa (2)

(1) Lviv Centre of Institute for Space Research, Laboratory for Electromagnetic Investigation, 5-A Naukova St., Lviv, 79060, Ukraine (fd@isr.lviv.ua, vakor@isr.lviv.ua, dd@isr.lviv.ua), (2) Volcanic Fluid Research Center, i6-34, Tokyo Institute of Technology, 2-12-1 Ookayama, Meguro, Tokyo, 152-8551, Japan (oga@ksvo.titech.ac.jp)

The ultra low frequency (ULF) lithospheric magnetic activity in the frequency range below 1 Hz is recently considered as one of the most informative evidence of an earthquake preparation process. However, the detection of such an activity meets some serious difficulties being touched the separation of such signals on the background of comparatively very intensive Pc3-Pc5 ionospheric/magnetospheric signals. Another hard problem is localization of signal source at so low frequencies.

For overcoming these obstacles the space selection method was developed in the Laboratory of Electromagnetic Investigations (LEMI) of Lviv Centre of Institute for Space Research. This method is based on synchronous data processing from two or more spaced magnetometers with use of magnetic field polarization ellipse technique. The method can be effectively applied to detection just a lithospheric magnetic activity and its separation from ionospheric/magnetospheric one [1].

The topic of keen interest is to apply this technique at the study of the pre-earthquake lithospheric magnetic activity for one of the greatest recent Earth's shock that was happened in Japan. On March 11, 2011 at 05:46:24 UTC the undersea megathrust earthquake hit the eastern coast of Japan with magnitude Mw=9.0 (so-called Tohoku earthquake). Its epicentre was in the point 38.30° N, 142.37° E with the nearest distance to Japan coast about 70 km. The hypocentre was at depth 29 km.

The data from two 3-component fluxgate magnetometers with sampling rate 1 Hz for period from January 1 to March 22, 2011 have been analyzed. The magnetometers are located in Esashi (ESA) geomagnetic observatory and Akasaka (AKSK) temporary measuring site with coordinates 39.18° N, 141.75° E, 39.24° N, 141.36° E respectively. The fluxgate magnetometer in AKSK site is a part of the long-period magnetotelluric station LEMI-417M. The distance between measuring points is about 35 km, while the mean distance from them to the epicenter of Tohoku earthquake is approximately 125 km. At application of the polarization ellipse technique the procedure of so-called blind search have been used to the rectangular monitored area with coordinates 38.19° N - 39.63° N and 141.51° E - 142.56° E, which includes the Tohoku earthquake epicentre. The monitored area 160x90 km with depth 0-70 km was decomposed into 8064 subblocks 5x5x5 km of total volume about 1,008,000 km³.

The pre-earthquake ULF lithospheric magnetic activity and peculiarities of its distribution in space, time and frequency areas in the monitored region have been analyzed. The obtained results on the background of the Kp index values will be discussed and presented.

1. Dudkin, F., Korepanov, V., Magnetic Field Polarization Ellipse: A New Approach for Detection of Pre-Earthquake Lithospheric Activity, Chapter in book "The Frontier of Earthquake Prediction Studies", 212-244, Japan, Tokyo, 2011.