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Earthquake precursors detection – new opportunity

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In spite of intensive research worldwide, the reliable recognition of earthquakes (EQ) precursors is still irresolvable problem. Some known examples of successful prediction in China and Greece are too seldom to have a hope that this might come true in near future.

Plenty of physical factors are reported in the literature as possible EQ precursors. Between them, lithospheric ultra low frequency (ULF) magnetic activity is recently considered as very promising candidate for application to short-time EQ forecasting. However the ULF lithospheric magnetic fields are very weak and are masked by permanently existing ionospheric and magnetospheric signals the intensity of which just in this frequency band is much stronger. Because of this the recognition of the magnetic activity connected with the EQ preparation process is very hard problem comprising both identification and localization of weak signal sources in the Earth's crust in the seismo-hazardous area.

To solve these tasks in order to find the position of a source of pre-EQ ULF electromagnetic activity of lithospheric origin a new approach is developed. It is based on a specially developed polarization ellipse technique to process the measurements data acquired from several, minimum two, synchronously sampled 3-component magnetometers. The polarization ellipse is formed by the magnetic field components at each measurement station in selected narrow frequency bands. It is shown that when we calculate the polarization ellipse parameters from at least two distant points this allows successful discrimination of seismo-electromagnetic signals from the natural background ULF signals of ionospheric origin.

This method is illustrated using the data from the fluxgate magnetometers installed in Sichuan province, China. Sichuan is a region of strongest seismic activity on territory of China. During last century about 40 earthquakes with magnitude more than MW 6.0 were happened here in close proximity to heavy populated zones.

The Panzhihua earthquake with magnitude MW 6.0 was happened in the southern part of Sichuan province on August 30, 2008 at 8:30:52 UT. The EQ hypocentre was located in the point with coordinates 26.28 N, 101.92 E at the depth 10 km. Special advantage of this event was that during all the year 2008 any seismic event took place besides the mentioned one. Then during the period August 30-31 – beginning September 2008 many clustered aftershocks with magnitude up to 5.6 also occurred there.

The data from three fluxgate magnetometers placed at this area near the clustered EQs at a distance 10-55 km from the epicentre of main shock have been processed. The separation between magnetometers was in the range 40-65 km.

The theoretical approach, observation method and obtained results are discussed. It is shown that the proposed method allowed reliable identification of ULF magnetic activity directly connected with EQ preparation process. Also the specially developed for EQ-related ULF signals monitoring instrumentation is presented and its parameters are given.

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