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# Geophysical methodology focused on natural hazard assessment due to extreme events (earthquakes and landslides) occurred on the Romanian territory

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The aim of this paper consists in establishing a methodology able to emphasize the short-term electromagnetic (EM) precursory parameters, useful for natural hazard assessment related to both the earthquakes (EQ) occurred at intermediate depth interval,characteristic to the seismic-active Vrancea zone, and the active faults that are considered to be sources of significant landslides in Subcarpathian area. It is well known that at Earth surface the geomagnetic component Bz is entirely secondary field and its existence is an immediate indicator of lateral inhomogeneity. Bz is produced essentially by Bperp. (precisely for 2D cases) and consequently a normalized Bz function defined as: Bzn = Bz/Bperp., where Bz is the vertical component of the magnetic induction and Bperp. is the horizontal geomagnetic component perpendicular to the strike orientation of the geological structure, should be time invariant for a given 2D structure (Stanica et al, 2002, 2003, 2004). Besides the electromagnetic parameter Bzn, the changes of the electric resistivities taken into consideration before, during and after a seismic event,have been analyzed, too. Therefore, in terms of resistivity, the normalized function Bzn may be estimated as: $^{3}$Bzn$^{3}$= (Rpar./Rz)1/2, where Rpar. is resistivity parallel to the strike orientation and Rz is vertical resistivity (Stanica, Stanica, 2003). As the first stage in getting to this aim it is important to determine the geoelectric pattern, in terms of non-seismic conditions and existence of a 2D structure, by using the continuous monitoring of the EM field in a site (Geophysical Observatory Surlari) placed at 140 km far away from the epicenter of the seismic Vrancea zone, taken as reference point for the electromagnetic anomalies generated by phenomena related to earthquakes. By means of the magnetotelluric (MT) tensor impedance decomposition procedure it was possible to separate the local effects from the regional

ones, to identify a 2D geological structure and to emphasize the strike orientation of the geological structure for frequencies corresponding to depths below crustal level. The selection methodology for precursory EM parameters was established according to the geotectonic features of the Vrancea zone and its surrounding areas. It is also necessary to mention that, according to the frequency range taken into consideration - corresponding to the subcrustal geodynamic processes-the processing and the analysis of the EM time series were accomplished in such a manner that these lead to the elaboration of a numerical scale for the anomalous fluctuations of the precursory parameters. Subsequently, a methodology focused on the correlation of the anomalous behavior of the Bzn electromagnetic parameter values with the earthquakes magnitude ($M>4$) recorded simultaneously, taking into consideration just their deviations from the geoelectric pattern initially calculated, was elaborated. To have a comprehensive view on the applied methodology, the daily average distribution of the parameter Bzn in correlation with Vrancea's deep seismic events occurred simultaneously during the last two years interval is revealed. Finally, we have to conclude that some days before an EQ occurred, the daily variation of the normalized function Bzn had had an anomalous behavior marked by a significant increase in respect with its standard deviation, as a result of the electrical conductivity changes that may be associated with the dehydration-induced faulting processes and fluid mitigation through cracks and faulting system developed inside the seismogenic volume and its neighboring zones. A similar methodology related to significant landslides areas due to active faults is presented, too.

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