Time-dependent seismic hazard assessment on the basis of monitoring seismicity behaviour in Vrancea region, Romania

M. Rogozea, M. Popa and M. Radulian

National Institute for Earth Physics, Bucharest-Magurele, 077125, Romania (mircea@infp.ro, Fax: +4021 4050673, Phone: +4021 4050669)

The seismic activity in the Vrancea region, located at the SE Carpathians arc bend, in Romania, consists of a strong cluster of earthquakes at intermediate depths (60 – 180 km). The atypical geometrical configuration of the hypocenters, elongated along NE-SW direction and close to a planar distribution, the persistence of the earthquake generation in time (around 15 events/month with $M > 3$ and around 3 events/century with $M > 7$), the predominance of the focal mechanism, raise a lot of questions and debates in connection with this interesting seismic area. The seismic network on Romanian territory was designed firstly to monitor the Vrancea area. Therefore, the detection and location of these events are of high accuracy and allow detailed and complex analyses related to seismicity evolution in time and space.

The purpose of this paper is to study the variation of the seismic activity in space and time, frequency-magnitude distribution, fractal dimension, deformation accumulation curve (Benioff's curve), on different time and space windows and to test any possible earthquake precursor. We use a high-quality catalog of Vrancea intermediate-depth events recorded by the seismic network of National Institute for Earth Physics between 1994 and 2006 and a routine catalog for a 70-year time interval. The refined catalog (based on JHD technique, used for hypocenters determination) is complete for duration magnitudes above 3 and contains only small and moderate earthquakes (M_w 5.8 was the largest observed magnitude). The study area, situated between 60 and 180 km depth, is divided in two active segments, one centered around 90 km depth, other centered around 140 km depth. The particular configuration of the foci along NE-SW direction allows a 2D approach.

The largest events are the most infrequent, but the most important to understand, since they control the evolution of the system and are the most destructive events. Our detailed pattern analysis suggests that recognizable patterns of smaller, more frequent events can be used to detect the generation of the next major event and that reliable forecasting of the largest events may be possible. We identify the characteristics of the preparation process of the strong subcrustal events originating in Vrancea region and analyze how they can be incorporated in a time-dependent seismic hazard assessment.

The evolution of seismic activity shows alternative accelerating and decelerating de-

formation release in the upper segment and lower segment, respectively, of the subducting lithosphere. The different seismicity behaviour in the two segments of the seismic active volume and the apparent interconnection between them can be speculated to predict the most probable future particular seismic hazard pattern. Our results are of highest interest if they are correct, since the focal depth parameter of the next major shock plays an essential role in the way the strong ground motion will be distributed geographically and implicitly in the pattern of the areas with strong damage. Implications of our approach for earthquake disaster management are discussed as well.