

## INTERMEDIATE DEPTH EARTHQUAKES DISTRIBUTION AND THEIR FOCAL MECHANISM IN VRANCEA ZONE, ROMANIA

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### ABSTRACT

In this paper, on the basis of the earthquakes catalog covering the time interval from 1982 to 1997 and comprising fault plane solutions, we analyze the distribution of the seismic activity on the Romanian territory. At the same time, the stress field characteristics, deduced from the available fault plane solutions, are investigated for different depth intervals. Predominant clusterings of the principal deformation axes and rupture plane orientation are observed in the Vrancea subcrustal domain in contrast with the earthquakes in the crust, which indicate no clear trending in the stress field.

The relatively large number of data provides important and reliable information to define from seismological point of view the limits of the tectonic plates.

**KEY WORDS:** Earthquake catalog, fault plane solutions, stress field

### 1. INTRODUCTION AND DATA ANALYSIS

The Carpathian Orogen is of Alpine age, composed of many Mesozoic and Cenozoic terrains. Back-arc volcanism, and back-arc extension in the Pannonian area, accompanied the Neogene subduction. A bent paleosubduction zone was recognized in the Eastern Carpathians, along which the original oceanic basement of flysch and the Subcarpathians nappes were consumed.

A small portion of this zone is still seismically active in the Vrancea area. This prominent south-eastern zone of the Carpathian Orogen lies above a nest of strong recent earthquakes (1940,  $M_W = 7.7$ ; 1977,  $M_W = 7.5$ ; 1986,  $M_W = 7.2$ ; 1990,  $M_W = 6.9$ ) situated between 60 and 200 km depth. This is the only place in the entire Carpathians where folding and thrusting occurred during Pleistocene in the outermost zones between two deep faults in the Moesian Platform. These recent crustal movements recorded in the area are accompanied by moderate crustal seismic activity (between 10 - 50 km depth and  $M_{max} = 5.5$ ), which together with intermediate depth seismicity produce high seismic risk in a densely populated area.

In Vrancea area, the original oceanic lithosphere descended to more than 200 km depth, as indicated by the intense intermediate depth seismic activity. Recent works in seismic tomography indicate that regional scale anomalies

of the seismic velocities are appearing down to 350 km depth (RADULIAN *et alii*, 2000).

The tectonic plate evolution of the whole Carpathian Arc and Pannonian back-arc Basin indicates that at least three tectonic units have been in contact and, at the same time, in relative motion: the East European Plate, the Moesian plate and the Intra-Alpine plate.

There were represented all the earthquake hypocenters from the period 1982 - 2000 situated in an area which includes Vrancea zone (25° - 28.5° E, 44.5° - 47° N). Because of the great number, they were found to describe well the limits of the tectonic plate (or plate fragment?) which is supposed to be subducted in this region until 200 km depth. These limits were put in direct relations with the known geology and tectonics of the area.

A conclusion to these observation is that at least 2 zones are present in the domain of the intermediate earthquakes: the first from 60 - 100 km and the second from 100-110 km to 200 km in depth. These 2 zones have clearly different characteristics both in the number of earthquakes occurred and also as the total released energy of the earthquakes occurred in each zone. They are also different in respect with the orientation angle of the blocks, which is changing at the same depth. The "transition zone" (around 90 - 110 km depth) appears as a relatively quiet seismic zone (TRIFU & RADULIAN, 1991; BALA *et alii*, 2001).

Available fault plane solutions for the intermediate depth earthquakes (1982 - 2000) are analyzed in several depth intervals indicated by the seismic activity. Correlation of the focal parameter in connection with the depth of the hypocenters is discussed. Some prominent orientations of the focal parameters appear, as can be seen in Fig. 1.

### 2. CONCLUSIONS

On the basis of an earthquake mechanism catalog presented by RADULIAN *et alii*, (2002), covering the time interval from 1929 to 1997, and completed for the period 1997-2000, we analyze the distribution of the seismic activity on the Romanian territory in connection with the seismogenic zones, previously defined, and geology and tectonics information. At the same time, the stress field characteristics, deduced from the available fault plane solutions, are investigated for depth intervals previously demonstrated to have different seismological characteristics.

Predominant clusterings of the principal deformation axes and rupture plane orientation are observed in the Vrancea subcrustal domain in contrast with the earthquakes in the crust (C), which indicate no clear trending in the stress field.

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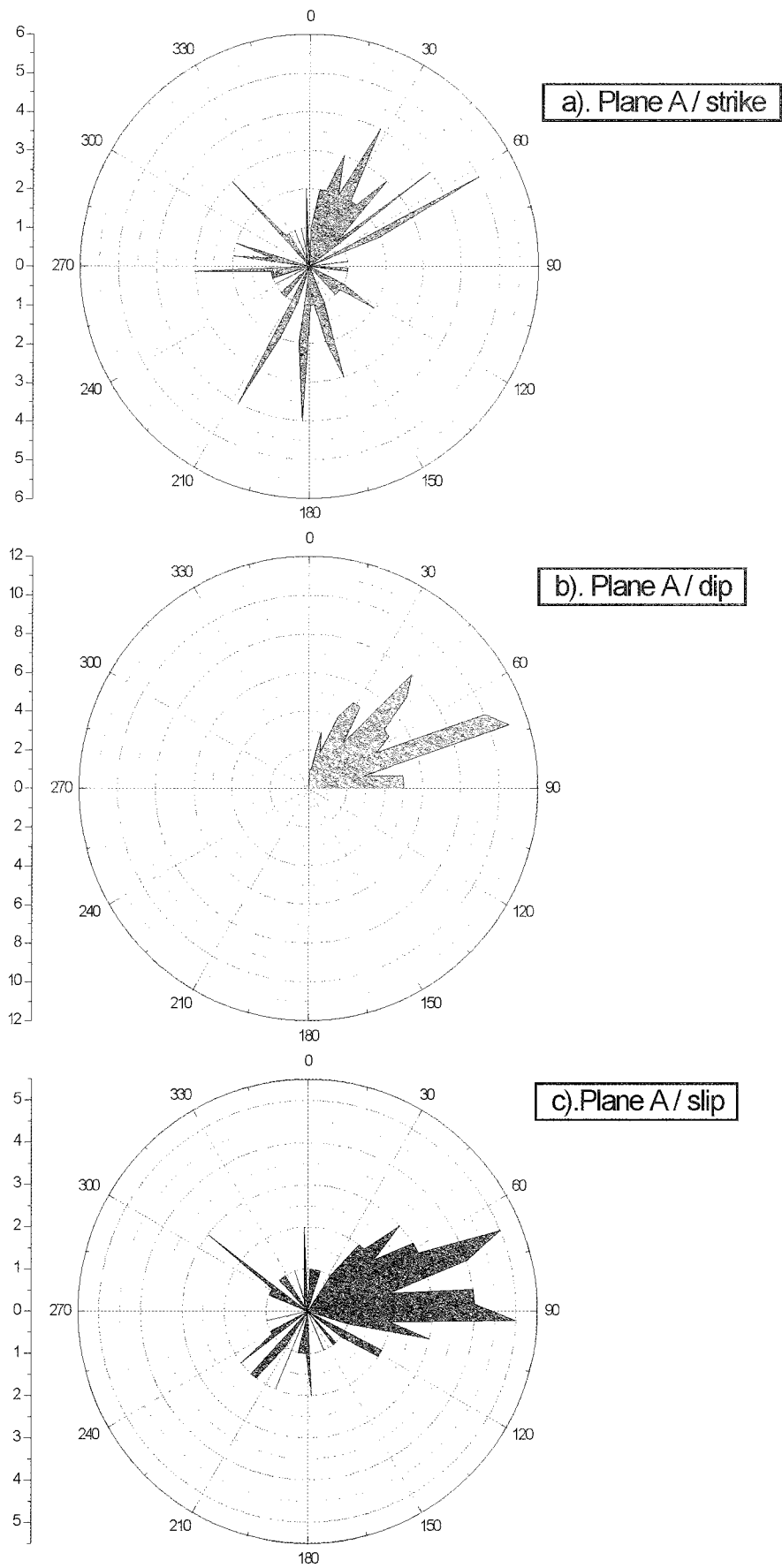


Fig. 1 - Focal parameters of the earthquakes in the depth interval 40 –100 km : a) strike; b) dip; c) slip.

At least two zones are present in the domain of the intermediate-depth earthquakes: the first from 60 - 100 km ( $I_1$ ) and the second from 100 km to 180 km depth ( $I_2$ ). These two zones have clearly different characteristics both in the number of earthquakes occurred and also as the total released energy of the earthquakes occurred in each zone. They are also different in respect with the orientation angle of the blocks, which is changing at the same depth. The "transition zone" (90 - 110 km depth) appears as a relatively quiet seismic zone.

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