NEW GEOPHYSICAL RESULTS ASSOCIATED WITH THE DEEP STRUCTURE OF THE PANNONIAN BASIN

T. FANCSIK, T. BODOKY, E. HEGEDŰS, I. KUMMER, K. POSGAY, M. TÁTRAI and CELEBRATION Working Group

In the second half of the 20th century significant amount of geophysical data were collected in Hungary. To utilising those data the Eötvös Loránd Geophysical Institute started a new project. In the scope of that an attempt is made to integrate all geophysical data in an interpretation process to build up a new 3D geological model of the crust below Hungary.

The CELEBRATION 2000 lithospheric experiment provided a great number of new data and contributed to the integrated interpretation with new possibilities as far as the deep structure of the Pannonian Basin is concerned.

This paper investigates the NW part of the Pannonian Basin and is focusing first of all on the Raba line by comparing the tomographic seismic velocity profiles of the CEL01, CEL07 and CEL08 basic lines of the CELEBRATION 2000 project with all those deep seismic sections and magnetotelluric soundings which are available within a given corridor along them. We show that the comparison reveals a number of phenomena which may essentially influence the present conception of the deep structure and the evolution of that region of the Pannonian Basin.

Studies of the last decade draw attention to the tight relationship between the Drauzug and the Transdanubian Central Range. The allochton character of the area investigated has been revealed by Majoros (1980), Báldi (1982), Kovács (1984) and Kázmér (1984), Kovács, Kázmér (1985). They suggest that the N-Pannonian alpine unit has been moved to its present position by horizontal displacements of the mid-alpine tectonic processes. Based on their results Balla (1985) says that the TRC (Transdanubian Central Range) unit moved away about 500 km from the Eastern Alps along the Raba line while it suffered deformations. Dudko (1990) analising the seismic and gravity data

found that that the Raba line was a major strike-slip boundary fault which cut the entire crust and separated two different crustal domains.
Contrary to the above cited authors Horvath (1993) states that the North-Pannonian alpine terrain escaped from its former position between the Eastern and Southern Alps and got to its present place as a complete and unbroken unit during the Oligocen and Miocen. He indicated the Carpathian arc as the northern and the Mid-Hungarian line as the southern boundary of the movements. He interprets the Raba line as former Cretaceous nappe boundary revived as listric fault during the Miocene.

Now, we are analysing and comparing with other geophysical data the results got from the seismic tomographic processing of the first arrivals along the CEL01, CEL07 and CEL08 lines.
The tomographic profiles of CEL07 and CEL08 show significant low velocity anomalies spreading over the total thickness of the crust at the Rába line which according to the literature and our model-computations can be interpreted as deep shear zones. On the same locations 2-D inversion profiles of magnetotelluric surveys indicate low resistivity zones extending down to the crust-mantle boundary and a nearby running seismic deep reflection profile supports the idea of a deep shear zone too. Regarding the concordant indications, which were provided by three different geophysical methods independent from each other, we say, that the Rába line is really a deep shear zone cutting through the crust and can be considered as a micro-continental boundary. With respect to the rheology its most probable explanation is a significant strike movement.
Analysing the profiles further to SE one can see that the Balaton line is a similar deep structure too. The TCR unit bordered by the two deep structural line doesn't show a uniform character on the profiles. On the CEL01 profile it forms a well separated syncline structure in the mid-crust region. A more accurate picture of the structural relations can be expected only from the areal (3-D) processing of the data.

Both the velocity tomographic and magnetotelluric profiles show further similar concordant phenomena in the Pannonian Basin, e.g. the CEL08

velocity and the corresponding magnetotelluric profiles indicate the breaking up of the Transdanubian Central Range down into the depth of the lower crust. One of the significant structural zones is marked both at the CEL01 and CEL08 lines by Quarternary basalt volcanic activities too.

Interesting results can be obtained if one investigates the relationship between the earth-quake hypo-centres connected to the neotectonics and the position of the Raba line got from geophysical data. The hypo-centres outline the structure well, which indicates that the structure has been revived and it is an important element of the young tectonics.

The Mid-Hungarian line can be identified on the CEL profiles as a large fracture zone extending down to the crust-mantle boundary, i.e. the new results confirm its tectonic significance. On the CEL08 profile the Mecsek-foot line can be also recognised, the profile suggests that the structure originally a thrust fault has been revived as a deep shear zone. The Sb-1 seismic reflection profile supports that idea too. It is very interesting, because that also indicates a significant strike slip tectonics in the Pannonian Basin.

Summarising the results it can be said that several deep tectonic zones cutting through the entire crust were found in the investigated area of the Pannonian Basin. Besides the Mid-Hungarian line the most significant one of them are the Rába and Balaton lines. It can also be seen that such a large tectonic unit as the TCR unit shows cosiderable diversity. Thus the following conclusion can be drawn: during the movements of the escape the North-Pannonian terrane was broken up to several parts and the different parts, if we compare them to each other, moved by different speeds as micro-continental fragments. The seismic tomographic and magnetotelluric profiles suggests that the strike-slip tectonics played one of the main roles in the regional history of the development of the Pannonian Basin. The analysis of the earth-quake data shows that the main structural lines represent potential displacement possibilities from the point of view of young tectonics.

We hope to obtain a more accurate picture of the structural relations of the Pannonian Basin from the future 3-D processing of the CELEBRATION 2000 seismic data.

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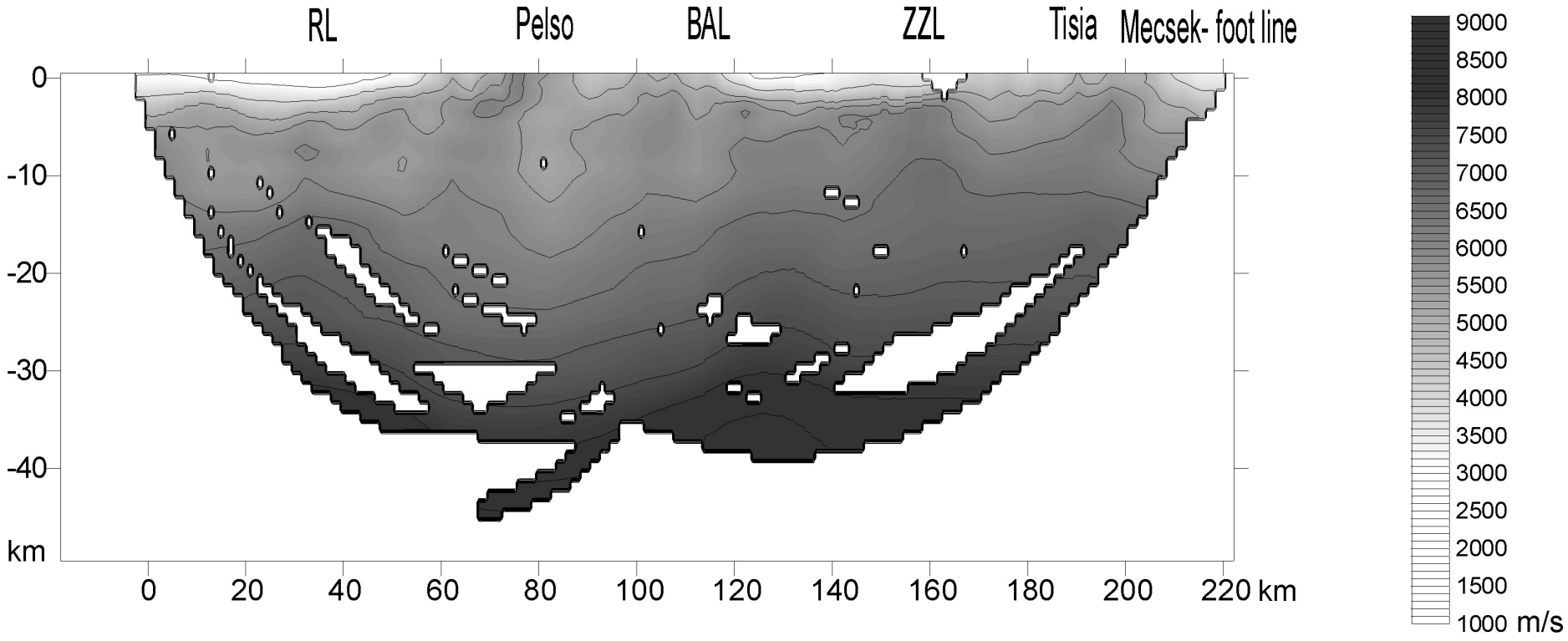

CEL08 tomographic profile

K1-MK3 magnetotelluric profile
with earth-quake hypocentres and seismic reflection horizonts