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Contact of the Western Carpathians with the European Platform in the light of seismic refraction data

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The Western Carpathians represent the northernmost segment of the European Alpides and form an arc-shaped mountain range related to the Alpine compression during the Cretaceous to Tertiary. Their outward termination shows the contact with the adjacent European Platform and the Bohemian Massif, units of different age and tectonometamorphic development. In the north and the west, the Western Carpathians are bordered by the flysch nappes thrusted over the Palaeozoic to Early Mesozoic margin of the European Platform and the Bohemian Massif.

The crustal-scale tectonic structure of the Western Carpathians and the European Platform, and especially their contact, were analysed employing the data of the CELEBRATION 2000 and SUDETES 2003 seismic refraction experiments. In the seismic wave field from profiles crossing the Carpathian arc, anomalous mantle phases were observed. The data were interpreted by 2-D trial-and-error forward modelling of P waves, additional constraints on crustal structure were provided by gravity modelling. The retrieved models were verified using the full wave field finite difference calculation. The modelling revealed a complex structure not only within tectonic units, but also at their contacts, which may reflect, to some extent, a structural variability related to tectonic events. The crustal thickness of the whole area varied from 25 – 39 km. The Moho in the Carpathians was relatively shallow and reached a depth of 32 – 33 km. This relatively small thickness, compared to many other Tertiary orogens, e.g., the Alps, reflected a different tectonic evolution of the Western Carpathians. In contrast, in the Pannonian Basin the Moho rose to a depth of 25 km which corresponded to the Pannonian gravity high and the Pannonian lithospheric thinning.

The most prominent lateral variations of the Moho depth were detected at the contact of the Western Carpathians with the Bohemian Massif. This area is unique because at the western margin of the Carpathians the Moho rises from 32 km to a depth of 26 km and steeply dips to the NW to a depth of 37 km. Similar feature was found at the northern edge of the Carpathians. The anomalies were located in close lateral proximity of the Pieniny Klippen Belt – a surface manifestation of the boundary between the colliding European and Alcapa plates. Therefore, this abrupt change of the crustal thickness seems to be tectonically related with possible continuation of this boundary to depth. The proximity between these two features (the Pieniny Klippen Belt and the abrupt Moho depth change) may suggest that the zone between them is an area of the contact of the European Platform plate and the Alcapa microplate.