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Seismic model of the crust and upper mantle across the Eastern Carpathians – from the Apuseni Mountains to the Ukrainian Shield

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The RomUkrSeis profile is a controlled source wide-angle reflection and refraction (WARR) profile acquired in August 2014. It is 675 km long, running roughly SW-NE from the Apuseni Mountains in Romania and the Transylvanian Basin behind the arc of the Eastern Carpathian orogen, crossing this and terminating in the East European Craton (EEC) in SW Ukraine. A well-constrained velocity model has been constructed along the RomUkrSeis profile from 350 single component seismic recorders and eleven shotpoints in a single deployment. The Eastern Carpathian arc and the complex tectonic processes that formed it in the Cenozoic have obscured the pre-existing Trans-European Suture Zone, which is the transition zone between the EEC and terranes accreted to its southwest in pre-Cenozoic (especially Palaeozoic) times.

Relatively low velocities are determined throughout the whole crust along the RomUkrSeis profile. The velocities in the southwestern part of the model (beneath the Apuseni Mts. and the Transylvanian Basin) are comparable with those of the Pannonian Basin (Vp <6.6 m/s) observed elsewhere while the crustal thickness is higher (>30 km). A high velocity body (Vp ∼6.36 m/s) appears at depths of 3-12 km, its location corresponding to the surface expression of ophiolites in the Apuseni Mts. Immediately below this body, lower velocities are found. In the central part of the model, there is a large sedimentary wedge that comprises the Cenozoic Carpathian foreland itself as well as older sedimentary units. The wedge consists of two thick layers characterized by Vp ∼4.7 and 5.35 km/s of ∼30 km width, asymmetrically dipping to the SW and reaching a depth of ∼15 km. Below it, up to a depth of 45 km, Vp value of ∼6.3 km/s is determined. On the EEC side of the model, the velocities near the crustal base (to depths 33-43 km) reach values of Vp ∼6.6 km/s. Strongly differentiated Moho depths are observed along the profile as a whole. Four segments can be identified from the southwest to the northeast, with depth variations from 32 to 50 km. Velocities below the Moho boundary are: 8.15-8.2 km/s and ∼8.3-8.35 km/s below a sub-Moho discontinuity in the uppermost mantle (at depths ∼52 km in the central part of the profile and ∼47 km in its northeastern part).

A comparative study of the RomUkrSeis profile and two other WARR profiles that cross the Eastern Carpathians, PANCAKE to the northwest and VRANCEA-2001 to the southeast, will illuminate important aspects of the relationship between the emplacement of the Carpathian arc and the earlier crustal architecture of this fundamental tectonic transition zone.

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