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Crustal structure of and boundary between the AlCaPa and Tisza terrains in the Pannonian basin

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The evolution of the Pannonian Basin is strongly linked to that of the surrounding Alpine, Carpathian and Dinaric orogens. The eastward extrusion of Alpine-type basement that accompanied lithospheric thinning must have been accompanied by mantle downwelling and/or subduction along the Carpathians but the motive forces for these movements are debated. The internal structure of the crust within the basin is mostly covered by relatively recent sedimentary infill whose variable thickness further complicates seismic imaging. Palaeomagnetic and geological data have, however, shown that two tectonic terrains of distinct origin: AlCaPa and Tisza, occupy the basin's NW and SE part respectively. The two units have undergone different amounts of extension during opposite orientation rotations (counter-clockwise and clockwise, respectively). The boundary between these two units, known as the Mid-Hungarian Zone, is recognized as a major sinistral shear zone, geophysically clearly marked across the basin by a trough in Bouguer gravity.

The Carpathian Basins Project deployed 49 broadband seismological stations perpendicular to the boundary between the AlCaPa and Tisza units. A NW-SE oriented swath of three lines covers a 450 km long and 75 km wide area. We use these and 4 permanent stations to image the crustal structure of and the boundary between AlCaPa and Tisza using the receiver function technique. The measured Moho depths show no significant change in crustal thickness between the two terrains, but the Moho is not or very weakly imaged along a ca. 40 km wide strip centred on the MHZ. Our Moho depths elsewhere in the basin agree with earlier controlled-source seismic results and recent shear-wave velocity models deduced from ambient noise analysis. The lack of a sharp Moho image beneath the MHZ implies that the crust-mantle boundary between AlCaPa and Tisza is not a sharp transition but rather a gradual increase in velocity with depth. The distinct low in gravity anomalies along this shear zone points to the same conclusion. Similar seismological observations of absent or unclear Moho conversion are made at the strike-slip boundary between terrains of the Tibetan Plateau, namely between the Lhasa and Qiangtang terrains at ca. 85°E longitude. The width of the deployed swath in the Pannonian Basin also allows us to observe crustal thickness variations orthogonal to the orientation of the array in both the AlCaPa and Tisza units. These variations can be explained with the variable amount of extension proposed by the geological record.