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Upper Mantle structure of the Pannonian-Carpathian region derived from Finite-Frequency Tomography

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The Pannonian-Carpathian system in Central Europe, consisting of the Pannonian Basin surrounded by the Alpine, Carpathian and Dinaric mountain belts, was formed in the Miocene after the Late Mesozoic continental collision between the Adriatic microplate and the European continent. The South Carpathian Mountain Range includes one of the most seismically active regions in Europe with large intermediate depth earthquakes occurring beneath Vrancea in the SE Carpathians. Better imaging of the mantle structure underlying the Pannonian-Carpathian system will further our understanding of the geological evolution and present dynamical state of the region. The South Carpathian Project (SCP) is a major temporary deployment (2009-2011) of seismic broadband systems extending across the eastern Pannonian Basin and the South Carpathian Mountains. In this project we aim to map the upper mantle structure in this part of central Europe with the objective of testing geodynamic models of the process that produced extension in the Pannonian, synchronous with convergence and uplift in the Carpathians. Here, we present high-resolution upper mantle structures beneath the region from finite-frequency tomography using P and S waves. We have selected teleseismic earthquakes with magnitude greater than 5.5, which occurred between 2005 and 2010. The data were recorded on 57 temporary stations deployed in the South Carpathian Project, 56 temporary stations deployed in the earlier Carpathian Basins Project (CBP), and 41 permanent broadband stations. The differential travel times are measured in high, intermediate and low frequency bands (0.5-2.0 Hz, 0.1-0.5 Hz and 0.03-0.1 Hz for both P-wave, 0.1-0.5 Hz, 0.05-0.1 Hz and 0.02-0.05 Hz for S-wave), and are inverted according to the 3-D finite-frequency formulation to produce P and S-wave velocity maps down to depths of about 800 km in the mantle. Our images show that the Vrancea seismicity occurs at the NE end of a tabular upper mantle high velocity structure that trends SW along the southern edge of the South Carpathians, oblique to the trend of the Carpathian range, and extending in depth to $\sim$400 km. Fast material extends across the centre of the Pannonian region below $\sim$300 km depth; it extends downward into the transition zone (MTZ) and appears to spread outward beneath the entire basin. The fast region in the MTZ is clearly bounded by slower material beneath the W. Carpathians and the Moesian platform. These results will be used in conjunction with 3D geodynamical modelling to help understand the geological evolution of this region.

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