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Geodynamical Interpretation of Crustal and Mantle Shear-Wave Velocity Structures Beneath the Carpathian-Pannonian Region

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The Carpathian-Pannonian system of Eastern and Central Europe represents a unique opportunity to study the interaction between surface tectonic processes involving convergence and extension, and convective processes in the upper mantle. The South Carpathian Project (SCP), a major temporary deployment (2009-2011) of seismic broadband systems extending across the eastern Pannonian Basin and the South Carpathian Mountains was set up with the purpose of bringing constraints on the geodynamical processes that have shaped the region. Imaging the seismic velocity structure of the crust and the upper mantle helps us to understand the structure and geodynamical evolution of this part of central Europe. Here, we present high-resolution images of both crustal and upper mantle shear-wave velocity structures beneath the Carpathian-Pannonian region using surface waves obtained from ambient noise tomography, and finite-frequency teleseismic tomography using S-wave arrivals, from 54 stations of the South Carpathian Project (SCP, 2009-2011), 56 stations of the Carpathian Basins Project (CBP, 2005-2007) and 131 national network broadband stations. For ambient noise tomography, we computed cross-correlations of vertical component continuous ambient seismic noise recordings for all possible pairs of stations and stacked the correlated waveforms over 1-2 years for the temporary stations and up to 5 years for permanent stations to estimate Rayleigh wave empirical Green's functions. Over 5700 final Rayleigh wave Green's functions were selected for the measurement of group velocity dispersion curves between 4s and 40s using the multiple-filter analysis technique. Group velocity maps are first computed on a grid discretized with 0.2°x0.2° steps from a non-linear 2-D tomographic inversion of measured group velocity dispersion curves. We then inverted the Rayleigh wave group velocity at each location to obtain the 3-D shear-wave velocity structure of the crust and uppermost mantle beneath the Carpathian-Pannonian region. In the finite-frequency teleseismic tomography of S waves, we have selected earthquakes with magnitude greater than 5.5 in the distance range 30°-95°, which occurred between 2006 and 2011. Using multi-channel cross-correlation technique, over 29661 and 41875 relative S arrival times were measured in high and intermediate frequency bands (0.1-0.5 Hz and 0.05-0.1 Hz) respectively. The relative arrival times are inverted for S-wave velocity distribution in the upper mantle according to the 3-D finite frequency kernel formulation. Our shear-wave velocity models provide a uniquely complete and relatively high-resolution view of the crustal and upper mantle structures in the region. We will discuss the interpretations of these velocity variations for the formation and geodynamical evolution of the lithosphere and upper mantle of the Carpathian-Pannonian region.