

Receiver functions image of Moho anomalies and of mantle lithospheric structure beneath the Carpathian area

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The Western Carpathians (WC) are the northernmost part of the Alpine orogenic system in Europe. Their geologically complex structure resulted from the Late Jurassic to Tertiary subduction of oceanic domains between the old European plate and mobile fragments of the Apulia/Adria lithosphere, ended by collision of these plates. Understanding the structure of the Carpathian lithosphere is crucial for unravelling its tectonic evolution. In this study, we employ the P-to-S receiver function (RF) method to image the depth and properties of the Moho discontinuity beneath the WC in Poland, Slovakia and Czech Republic. We also calculate S-to-P receiver functions to trace the lithosphere-asthenosphere boundary in the area of research. We used seismograms of ~60 temporary broadband stations and several permanent stations spanning the Carpathian arc along the Pieniny Klippen Belt (PKB), a boundary between Inner and Outer Carpathians and a presumed surface manifestation of the European plate-ALCAPA microplate. Temporary stations operated in the frame of the PACASE and AdriaArray experiments, targeting passive seismic studies of the Carpathian-Pannonian upper mantle.

Analysis of calculated RFs was done with three methods – RF stacking for individual stations, H-k stacking to model Vp/Vs ratio and Moho depth, and common conversion point (CCP) stacking along 3 profiles, perpendicular to the Carpathian arc and to the PKB. Results document variations of Moho depth over the region – 40-35-30 km beneath Outer Carpathians and 30-25 km beneath Inner Carpathians and Pannonian Basin. An outstanding feature is linear, sharply delimited anomaly of the Moho, located close to PKB (discontinuous Moho image and local depth increase by ~10-15 km, visible in all profiles). This supplements new information to previous observations based on Pn refractions along wide-angle seismic profiles. Observed anomalies of the Moho, spatially correlating with the course of the PKB, are likely to be a deep manifestation of the collisional/transpressional contact between European plate in the North and ALCAPA in the South.