



Full waveform modelling of the anomalous upper mantle seismic phases in the Western Carpathians – a trace of the plates contact at the Moho level?

P. Sroda (1) and P. Hrubcova (2)

(1) Institute of Geophysics, Polish Academy of Sciences, Warszawa, Poland (psroda@igf.edu.pl), (2) Institute of Geophysics, Academy of Science of the Czech Republic, Prague, Czech Republic (pavla@ig.cas.cz)

The contact area of the Western Carpathians and the European Platform was covered by several seismic wide-angle profiles of the CELEBRATION 2000 and SUDETES 2003. Based on these data, the 2-D models of the crustal and upper mantle structure show substantial variability in the structure, especially at the Moho level. Moreover, in the seismic wave field from profiles crossing the Carpathian arc (CEL09, CEL15 and S04), anomalous mantle phases were observed. The Pn phase exhibits a significant decrease of the apparent velocity, a travel time delay and an increase in the amplitude. This phenomenon occurs consistently in the area between the Inner and Outer Carpathians and cannot be explained by anomalies in the upper crust where the velocity is well constrained by crustal arrivals. At the same offsets as the anomalous Pn phase, secondary arrivals with a diffraction-like character are sometimes observed.

In order to investigate the origin of these phases, the seismic data were modelled by two methods. First, the 2-D trial-and-error forward ray-tracing modelling of P waves was applied, followed by finite-difference full waveform calculation of synthetic seismograms. The character of the observed anomalous arrivals varies so that we focus on presenting several plausible models of the anomalous structure that can explain the wave field characteristics and discuss them in terms of their probable tectonic implications. We discuss also the advantage of the full waveform approach for modelling of such structures.

The modelling results suggest that the anomalous phases can be explained by a sharp (sub-vertical) Moho step with amplitude of 5-10 km or by a local disturbance of the Moho depth of similar size. Analogous structures at the Moho level, thought to produce diffraction-like arrivals, were previously modelled at some 300 km further east along the Carpathian arc beneath the Inner/Outer Carpathians contact. The location of these anomalies in a long and narrow zone following the strike of the orogen and the European plate margin may suggest its origin as a result of the convergence of Alcapa and European plates which was a driving force of the orogeny.