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Mantle Under the Vrancea Zone - Evidence from Dispersion of First-arriving P-Waves

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The Vrancea region of the south-eastern Carpathians is one of the most active seismic zones in Europe and is known for its intermediate-depth seismicity, e.g., there are strong earthquakes in a very limited seismogenic volume at intermediate-depth (70-180 km). Seismic tomography has shown a high-velocity body in that anomalous zone, extending to a depth of at least 350 km. That high-velocity body has been interpreted either as a descending lithospheric slab or as mantle lithosphere. Indeed, the regional geodynamic models proposed for this area can be split into two main model assumptions: (a) The mantle seismicity in Vrancea is associated with a descending relic oceanic lithosphere (attached or already detached from the continental crust) beneath the bending zone of the SE-Carpathians, or (b) the intermediate depth earthquakes are caused by delamination of mantle lithosphere due to continental collision and orogenic thickening.
In order to shed more light on the origin of the intermediate depth seismicity in the Vrancea zone, we investigate the frequency-dependence of P-wave group arrival times of local earthquakes excited beneath this area. Dispersed P-waves have been observed in many subduction zones around the world. A most natural, and almost exclusive, explanation is based on the upper few kilometers of subducted oceanic crust that are seismically distinct from surrounding material. Such a low-velocity layer several kilometers thick acts as a waveguide, causing higher frequencies to arrive later than lower frequencies. For Vrancea, such dispersion is observed at several stations sited at the bending zone of the SE-Carpathians while signals at a reference station further northwest do not show such a behaviour. The main interest of this technique is that it provides constraints that classical seismic tomography can not give, since the low-velocity channel is too thin to be resolved by the latter technique. The presence of a tabular and inclined low-velocity suggests the presence of subducted oceanic lithosphere rather than continental lithospheric delamination as the best simple geodynamic model for the area.