Abstract
The Vrancea region of the south-eastern Carpathians is one of the most active seismogenic zones in Europe and is known for its intermediate depth seismicity (70-180 km). Seismic tomography revealed a high-velocity body beneath Vrancea and the Mocsen platform that extends to a depth of at least 350 km and can be interpreted as descending lithosphere. The many regional geodynamic models that have been proposed for this area can be split into two main categories. The high-velocity anomaly is associated with (a) descending relic oceanic lithosphere beneath the bending zone of the SE-Carpathians, either attached or already detached from the continental crust, or (b) continental lithosphere that has been delaminated, after continental collision and orogenic thickening. In order to shed more light on the nature of the seismic anomaly under the Vrancea region, as well as that of the origin of the intermediate depth seismicity in the Vrancea zone, we investigate the waveform character of P-waves from local earthquakes excited beneath this area, and in particular the dependence of group arrival times on frequency. A natural explanation for that effect is that it is caused by the presence of a low-velocity channel at the top of the seismic anomaly, which is too thin to be resolved by classical seismic tomographic techniques. This is similar to observed low-velocity layers with a thickness of several kilometers that is found to exist atop many slabs in subduction zones around the world. The presence of subducted oceanic crust suggests that the seismic anomaly under the Vrancea region consists of subducted oceanic lithosphere rather than continental lithosphere, at least above the seismically active zone.

Study Region
The earthquake distribution in the South-Eastern Carpathians shows a strong concentration of intermediate-depth seismicity (70-180 km) in the Vrancea region. In 1999 the CALIXTO field experiment (Carpathian Arc Lithosphere X-Tomography) with 143 seismic stations was conducted in south-eastern Romania. Data inversion revealed a high velocity body interpreted as a descending lithospheric slab [1]. We examine waveforms of direct P-waves for 61 local events with magnitude > 2, recorded at a subset of the CALIXTO network of 17 stations (blue triangles) situated in the area above the supposed near-vertical slab. Events > 70km depth that show dispersion are represented by yellow circles. (right) Vertical cross-sections of hypocenter distribution on the SW-NE profile P1 (top) and the NW-SE Profile P2 (bottom). Events with M>2 are taken from the NEIC Event Database between 1980 and 2013.

Ray paths
Map view (top) and vertical cross-sections of ray paths for the two profiles P1 and P2 (bottom) from events-station pairs, where dispersion was observed for 18 events (red lines), and not observed at others (black lines). Dispersion observations occur mainly at stations situated a view kilometers north-east of the event epicenter. The table shows the number of observations at each station that do and do not show dispersion.

Conclusion
This suggests that the high-velocity anomaly under Vrancea consists of subducted oceanic lithosphere, at least the zone above the seismically active portion.

References