Prominent crustal discontinuities in Reykjanes Peninsula, Iceland

Pavla Hrubcová, Jana Doubravová, and Josef Horálek
Institute of Geophysics CAS, Seismology, Prague, Czechia (pavla@ig.cas.cz)

Iceland, situated in the North Atlantic Ocean between Greenland and Norway, is located above the Mid-Atlantic Ridge. It is a part of the oceanic crust forming the floor of the Atlantic Ocean. Its tectonic structure is characterized by various seismically and volcanically active centers. We focused on active seismicity in the SW part, where the Reykjanes Ridge segment of the Mid-Atlantic Ridge is located in Reykjanes Peninsula as the landward ridge continuation connecting it to the Western Volcanic Zone. The seismicity in this area is monitored by REYKJANET seismic network stations operated by IGF CAS. The earthquakes are released in form of swarms and are largely confined to the upper few kilometers of the oceanic layer related to a large number of faults and fissures with the high seismic activity at depths of 2 to 6 km, however, some events may be as deep as 13 km.

Since knowledge of a detailed crustal structure is essential for all advanced studies of seismicity and focal parameters of the earthquakes, we concentrated on velocity model and prominent discontinuity depth retrieval in the area. We selected the best located events of the 2017 swarm in Reykjanes Peninsula and refined their locations by manual picking. This resulted in processing of waveforms from earthquakes with magnitudes >1 recorded at 15 REYKJANET seismic network stations. The waveforms typically displayed dominant direct P and S waves followed by converted and reflected waves secondarily generated at shallow and deeper subsurface structure. We tested a multi-azimuthal approach in data processing of Hrubcová et al. (2013; 2016) to increase resolution of these phases in the waveforms. We applied the waveform cross-correlation of the P and S waves, and rotated, aligned and stacked the seismograms to extract the reflected/converted phases. In the interpretation, we focused on the most prominent interface at the crust/mantle boundary, the Moho, and processed its reflected phases. These phases were inverted for laterally varying Moho depth by ray tracing and a grid search inversion algorithm and verified by modeling of full waveforms computed by the discrete wave number method.