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Depth-dependent Q-models for the crust in the Vrancea region and surroundings by high frequency waveform modelling

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A method based on high frequency waveform modelling is proposed to estimate depth-dependent models for the quality factor of the medium in the area located at the bending of the Eastern Carpathians.
The algorithm is a non-linear inversion in which the normalised amplitude spectra of the records of low to moderate magnitude earthquakes are compared with the spectra of the synthetic signals, generated as response of the structure to instantaneous point sources with the same location and mechanism as the recorded event. The best fitting Q-model is selected by minimizing the sum of squares of logarithmic residuals between theoretical and observed spectra.
The technique applied to compute the synthetic seismograms is the multimodal summation, a method which allows to synthesize the complete wavefield in preassigned intervals of frequencies and phase velocities. The maximum frequency considered is 5 Hz, and calculated spectra of both theoretical waveforms and records are smoothed by averaging the amplitudes for a band width of 1 Hz.
The models for the elastic parameters of the medium along the focus - recording station paths (velocities of the seismic waves, and density) are 1D structures consisting of several homogeneous layers for the sedimentary cover and two layers for the crystalline crust (the upper and the lower crust); they are constructed as realistically as possible on the basis of the most recent information available, by integrating and harmonizing published results, after a critical evaluation and selection.
The time window used in the analysis varies between 10 and 20 seconds and it includes the most energetic part of the signals (data and synthetics). To avoid the effect of the data noise, the misfit function is evaluated only for the frequency range where the signal-to-noise spectral amplitude ratio is greater than 2.
The effect of the uncertainty of the structural models considered for the elastic parameters, as well as the effect of the source depth on the resolution of the best-fitting Q structures were also investigated.