Geophysical Research Abstracts
Vol. 16, EGU2014-12361, 2014
EGU General Assembly 2014

Attenuation of seismic waves obtained by coda waves analysis in the West Bohemia earthquake swarm region

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Seismic waves are attenuated by number of factors, including geometrical spreading, scattering on heterogeneities and intrinsic loss due the anelasticity of medium. Contribution of the latter two processes can be derived from the tail part of the seismogram – coda (strictly speaking S-wave coda), as these factors influence the shape and amplitudes of coda.

Numerous methods have been developed for estimation of attenuation properties from the decay rate of coda amplitudes. Most of them work with the S-wave coda, some are designed for the P-wave coda (only on teleseismic distances) or for the whole waveforms. We used methods to estimate the 1/Qc - attenuation of coda waves, methods to separate scattering and intrinsic loss – 1/Qsc, Qi and methods to estimate attenuation of direct P and S wave – 1/Qp, 1/Qs.

In this study, we analyzed the S-wave coda of local earthquake data recorded in the West Bohemia/Vogtland area. This region is well known thanks to the repeated occurrence of earthquake swarms. We worked with data from the 2011 earthquake swarm, which started late August and lasted with decreasing intensity for another 4 months. During the first week of swarm thousands of events were detected with maximum magnitudes ML = 3.6. Amount of high quality data (including continuous datasets and catalogues with an abundance of well-located events) is available due to installation of WEBNET seismic network (13 permanent and 9 temporary stations) monitoring seismic activity in the area.

Results of the single-scattering model show seismic attenuations decreasing with frequency, what is in agreement with observations worldwide. We also found decrease of attenuation with increasing hypocentral distance and increasing lapse time, which was interpreted as a decrease of attenuation with depth (coda waves on later lapse times are generated in bigger depths – in our case in upper lithosphere, where attenuations are small). We also noticed a decrease of frequency dependence of 1/Qc with depth, where 1/Qc seems to be frequency independent in depth range of upper lithosphere. Lateral changes of 1/Qc were also reported – it decreases in the south-west direction from the Novy Kostel focal zone, where the attenuation is the highest. Results from more advanced methods that allow for separation of scattering and intrinsic loss show that intrinsic loss is a dominant factor for attenuating of seismic waves in the region. Determination of attenuation due to scattering appears ambiguous due to small hypocentral distances available for the analysis, where the effects of scattering in frequency range from 1 to 24 Hz are not significant.