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Seismic waves attenuation in the lithosphere of the northern Basin and Range Province

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The seismic quality factor of the direct body waves (P- and S-waves) and coda and their frequency dependence (n) were estimated for the northern Basin and Range Province using traces of 66 local earthquakes and explosions recorded during 1988-1989 PASSCAL Basin and Range Passive Seismic Experiment. For calculation of Q-coda the single backscattering model by Aki was used. Q-coda values were estimated for six central frequencies (f): 0.3±0.1, 0.75±0.25, 1.5±0.5, 3.0±1.0, 6.0±2.0 and 12.0±4.0 Hz and for 18 lapse time windows (W) – from 10 to 95 sec with a step 5 sec. The Qp and Qs values were obtained by the method of the maximum amplitudes for the frequency bands 0.5–1.0, 1.0–2.0, 2.0–4.0 4.0–8.0 Hz. Also we tired to evaluate the part of the intrinsic and scattering attenuation (Qi and Qsc respectively) in the total attenuation using Wennerberg's method.

The Q-coda increases and the frequency parameter n and the attenuation coefficient δ decrease with increasing of frequency and lapse time windows. This fact shows that the upper part of the lithosphere is more heterogeneous compared to its lower layers. The deep variations of the frequency parameter n and the attenuation coefficient δ show the sharp change at the depth about 150 km – at the same depth the boundary of the low velocity anomaly is observed (Bensen et al., 2009; Wagner et al., 2012; Shen et al., 2012).

The Qs and Qp values also increase with frequency: Qs varies from 42 (0.84 Hz) to 298 (5.52 Hz) and Qp – from 60 (0.84 Hz) to 279 (6.05 Hz). The following empirical relations of Q vs. f are deduced for P- and S-waves respectively: Qp(f)=69*f0.78 and Qs(f)=53*f1.08. The Q-values, describing the intrinsic and scattering attenuation, also show a significant dependence on frequency and lapse time windows: the empirical relations of Q vs. f are: Qi(f)=8*f1.2 and Qsc(f)=13*f1.1 (for W=10 sec) and Qi(f)=5*f1.2 and Qsc(f)=102*f1.0 (for W=95 sec) respectively. The comparison of the intrinsic and scattering attenuation shows that the intrinsic attenuation is dominant over scattering attenuation in the frequency range analyzed for all deep levels.

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