8th International Conference on Seismology & Earthquake Engineering
11-13 Nov. 2019, Tehran, Iran

ESTIMATION OF THE SOURCE PARAMETER FROM ACCELERATION SPECTRA OF THE TAZEHABAD-KERMANSHAH EARTHQUAKE 2018

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Keywords: Source parameters, Shear wave, Quality factor, Strong motion data

Strong earthquakes occurred on August 26, 2018 (M_W 5.9) in the Kermanshah Province, West of Iran. High-frequency strong-motion data of this earthquake has been analyzed to determine the source parameters and $Q_\beta(f)$ by inversion of the recorded data. We have used the data from a local network of 26 acceleration records for the main shocks to estimate Q-relationship in 26 stations. The seismic hazard map for this region illustrates that most of the area in this province is located within high relative risk and characterized by a large number of heterogeneities. For frequency band of 1 to 20 HZ, the frequency-dependent attenuation for this region found to be $Q_\beta(f) = (101 \pm 19)\, f^{(0.76 \pm 0.05)}$. The authenticity of achieved $Q_\beta(f)$ relation is checked by comparing the source spectra in various stations with the theoretical spectra. Low values of the coefficient ($Q < 200$) in the $Q_\beta(f)$ relation suggest that the region is seismically and tectonically active. According to table (1), as expected radius rupture has inversely proportional to the corner frequency.

Table 1. Source parameter in some random stations.

No.	Station Name	Corner Frequency (f_c)	Stress Drop ($\Delta\sigma$)	Radius Rupture
1	Degaga	0.23	23.71	5.31
2	Shoeisheh	0.12	4.32	10
3	Qasr-e Shirin	0.16	10.04	7.82
4	Kamyaran	0.25	38.71	5.06
5	Sarpol-e Zahab	0.21	23.11	6.01
6	Palangan	0.34	98	3.76

INVERSION

Organizing inversion matrix is the first step in the inversion methods. In this article, we use an inversion scheme for obtaining frequency-dependent $Q_\beta(f)$ by using least-squares inversion technique for a nonsingular matrix and singular value decomposition technique for a singular matrix. The advantage of using strong-motion data for the inversion is that it includes valuable high-frequency near-field data suitable for engineering use.

The acceleration spectra of shear waves at a distance R due to an earthquake of seismic moment M_0 can be given as (Boore, 1983; Atkinson and Boore, 1998):

$$A(f)=C.\ S(f).D(f) \qquad (1)$$

where C is constant at a particular station for a given earthquake, S(f) represents the source acceleration spectra, and D(f) denotes a frequency-dependent diminution function that modifies the spectral shape and is given as (Boore and Atkinson, 1987):

$$D(f)=\left[\frac{e^{\frac{-\pi f R}{\beta Q(f)}}}{R}\right]P(f,f_m) \tag{2}$$

$$C = M_0 R_{\theta\varphi}.FS.PRTITN/\left(4\ \pi\rho\beta^3\right) \tag{3}$$

I matrix can be represented in the following form:

$$GM = d \tag{4}$$

Model parameters are contained in the model matrix M, and the spectral component is in the data matrix d. Inversion of the G matrix using Newton's method gives the model matrix M as:

$$Mest = (G^T\ G)\text{-}1\ G^T\ d \tag{5}$$

By implementing inversion on records, the average $Q_\beta(f)$ relationship is obtained by using the average of $Q_\beta(f)$ values. The average values of $Q_\beta(f)$ for region stations are given in Table 2. The iterative inversion was performed at each station independently.

Table 2. Quality Factor in some random stations.

No.	Station Name	Corner Frequency (f_c)
1	Degaga	$Q_\beta(f)=181f^{0.52}$
2	Shoeisheh	$Q_\beta(f)=113f^{0.84}$
3	Qasr-e Shirin	$Q_\beta(f)=139f^{0.64}$
4	Kamyaran	$Q_\beta(f)=75f^{0.83}$
5	Sarpol-e Zahab	$Q_\beta(f)=79f^{0.73}$
6	Palangan	$Q_\beta(f)=66f^{0.96}$

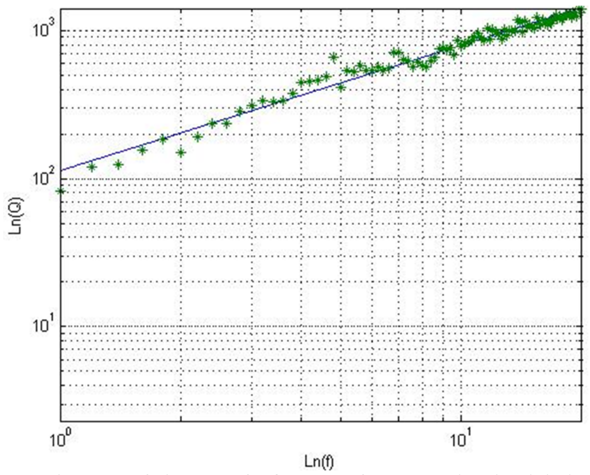

Figure 1. The rate of change of Qβ versus frequency in Shoeisheh station.

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