Q-values for P and S waves in Southern Sinai and Southern Gulf of Suez Region, Egypt

Gad-Elkareem Abdrabou Mohamed

National Research Institute of Astronomy and Geophysics

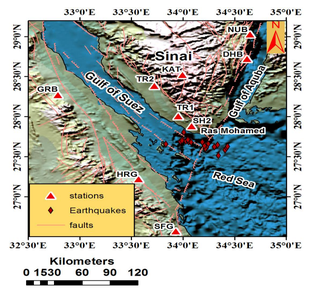
DEFINITION OF *Q* -VALUE

We commonly experience that as a seismic wave is propagated through the earth's interior, wave amplitudes attenuate as a result of a variety of processes. These processes are usually summarized macroscopically as internal friction. Quality factor *Q* is a dimensionless quantity that summarizes the gross effect of internal friction (Aki and Richards, 1980).If a volume of material is cycled in stress at a frequency *f,* then, the dimensionless *Q* is

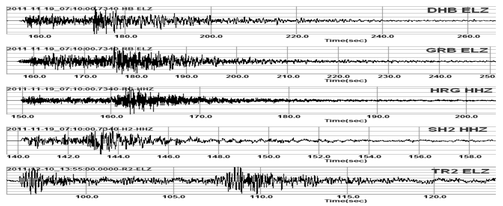
$$Q(\omega)^{-1} = -\Delta E/2\pi E,$$

where $\omega = 2\pi f$, E is peak strain energy stored in the volume, and $-\Delta E$ is the energy lost in each cycle.

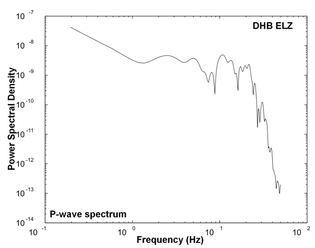
The quality factor Q has been estimated using spectral amplitudes of P and S waves from earthquakes recorded at nine stations have been used in this study. The spectral amplitude ratios have been calculated between 2 - 20 Hz and single station spectral ratio method has been applied

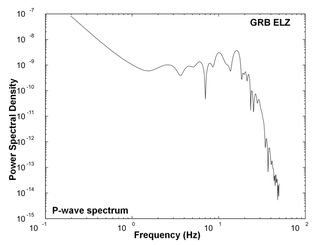


distribution of stations and epicenter location of earthquakes which used in this study.



Examples of seismograms recorded at stations which were used.



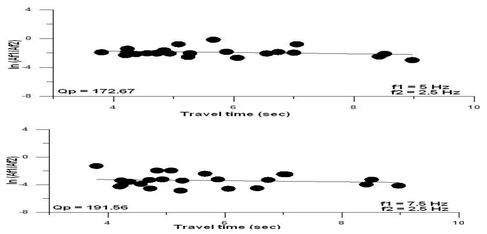


P-wave spectrum

INSTRUMENTS AND DATA

We have used 28 earthquakes of magnitudes between 1.5 and 4.6; they are recorded by NUB, DHB, KAT, TR1, TR2, SH2, GRB, HRG and SFG seismic stations from the Egyptian National Seismological Network (ENSN). The stations (DHB, GRB, NUB, SFG, TR1 and TR2) are short period, one component and sensor type is SS1, while the stations (HRG and SH2) are very broad band, three components and sensor type is Trillium 240 and the station KAT is broad band three component with Trillium 40 sensor. Sampling rate of all stations is 100 s/s.

Estimation of *Qs* [(*Q0*) and n]

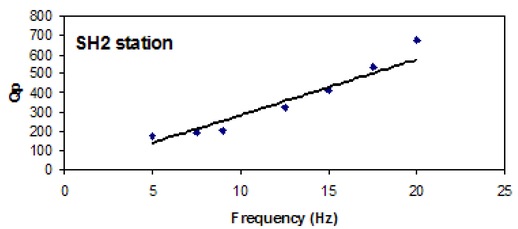


Station	$Q_{0\text{-}S}$	n
HRG	14.59	1.003
KAT	11.11	1.01
SH2	49.73	1.08

Plots of log of spectral ratios versus time along with the best least square fitted line for Qp for the station SH2.

Estimation of *Qp* [(*Q0*) and n]

the slope = $-\pi(f_1 - f_2)/Q$



Relation between Qp and frequency according to power low $Q = Q_0 f^n$ for SH2 station.

Station	$Q_{0\text{-}P}$	n
DHB	4	0.92
GRB	17.93	1.18
HRG	13.1	0.98
KAT	12.14	0.91
NUB	35.75	0.61
SFG	3.8	0.96
SH2	26.24	1.03
TR1	20.43	0.94
TR2	14.14	1.15

CONCLUSIONS

The single station spectral method has been used to estimate the quality factors of P and S waves of the earthquakes recorded at DHA, NUB, TR1, TR2, KAT, SH2, GRB, HRG and SFG stations in the study region. The average frequency dependent relations for *Q* have been estimated as:
Qp = (13.15± 0.76) f0.95± 0.19 and *Qs* = (20.05± 0.79) f1.03±0.04 in the region. When *Qs*/*Qp* is larger than 1.0 this suggest dry crust for most of the region. The frequency dependent relations developed here may be useful for the near source simulation of earthquake strong ground motion as well as the estimation of the source parameters for the earthquakes in the study area.

REFERENCES

Anderson, D. L., Ben-Menahem A and Archambeau 1965. Attenuation of seismic energy in the upper mantle; *J. Geophys. Res.* **70** 1441–1448.

Bakun, W. H. and Bufe, C. G., 1975. Shear wave attenuation along the San Andreas fault zone in central California, Bull. Seism. Soc. Am., 65, 439-459.

Ben-Avraham, Z., Almagor, G., Garfunkel, Z. 1979. Sediments and structure of the Gulf of Elat(Aqaba), northern Red Sea. Sediment. Geol. 23, 239–267.

Bianco, F., M. Castellano, E. Del Pezzo, and M. J. Ibanez 1999. Attenuation of short period seismic waves at Mt. Vesuvius, Italy, *Geophys. J. Int.* **138,** 67–76.

Borcherdt, R. D., 1970. Effects of local geology on ground motion near San Francisco Bay, Bull. Seism. Soc. Am., 60, 29-61.

Bosworth, W., McClay, K.R. 2001. Structural and stratigraphic evolution of the Gulf of Suez rift, Egypt: a synthesis. In: Ziegler, P.A., Cavazza, W., Robertson, A.H.F., Crasquin-Soleau, S. (Eds.), Peri-Tethys Memoir 6: Peri- Tethyan Rift/Wrench Basins and Passive Margins. Memoires du Museum National d' Histoire Naturelle de Paris 186, 567–606.

Tsujura, M., 1966. Frequency analysis of seismic waves: 1, Bull. Earthq. Res. Inst., Tokyo Univ., 44, 873 – 891.