

[Home](#) > [Journal](#) > [Earth & Environmental Sciences](#) > [IJG](#)
[Indexing](#) [View Papers](#) [Aims & Scope](#) [Editorial Board](#) [Guideline](#) [Article Processing Charges](#)
[IJG](#) > Vol.3 No.1, February 2012

OPEN ACCESS

Attenuation of P, S and Coda Waves in the NW-Himalayas, India

PDF (Size: 1412KB) PP. 179-191 DOI: 10.4236/ijg.2012.31020

Author(s)

Imtiyaz A. Parvez, Preeti Yadav, K. Nagaraj

ABSTRACT

The frequency-dependent characteristics of P- and S-wave attenuation in the upper crust of NW Himalayas have been estimated using local earthquakes for a frequency range of 1.5 to 18 Hz. A total of 43 local events of magnitude 2.1 - 4.8, mostly from the vicinity of Main Boundary Thrust (MBT) and Main Central Thrust (MCT) have been used in the analysis. The extended coda normalization methods were applied to estimate the quality factors for P- waves (Q_p) and S-waves (Q_s) and the single back-scattering model has been used earlier (Kumar *et al.* [1]) to determine the quality factor for coda waves (Q_c). The observed quality factors Q_p and Q_s is strongly frequency dependent and the estimated average frequency dependent relation is given by $Q_p = (97 \pm 3)f^{(1.06 \pm 0.06)}$ and $Q_s = (127 \pm 6)f^{(0.96 \pm 0.06)}$ respectively for P- and S-waves. A comparison of Q_s estimated in this study and Q_c previously reported shows that $Q_c > Q_s$ for entire frequency range. This indicates the enrichment of coda waves and the importance of scattering attenuation to the attenuation of S-waves in the study region infested with faults and fractures. The ratio Q_s/Q_p is found to be greater than unity for the entire frequency range indicating that the body waves from source to station paths crossed a crustal volume with dry and rigid rocks. The frequency dependent relations developed in this study can be very useful to ground motion modeling which in turn is required in the seismic hazard assessment of the region.

KEYWORDS

Attenuation; Quality Factor; Frequency Dependence; NW Himalayas

Cite this paper

 I. Parvez, P. Yadav and K. Nagaraj, "Attenuation of P, S and Coda Waves in the NW-Himalayas, India," *International Journal of Geosciences*, Vol. 3 No. 1, 2012, pp. 179-191. doi: 10.4236/ijg.2012.31020.

References

- [1] N. Kumar, I. A. Parvez and H. S. Virk, " Estimation of Coda Wave Attenuation for NW Himalayan Region Using Local Earthquakes," *Physics of the Earth and Planetary Interiors*, Vol. 151, No. 3-4, 2005, pp. 243-258. doi:10.1016/j.pepi.2005.03.010
- [2] H. Sato, " Thermal Structure of the Mantle Wedge beneath Northeastern Japan: Magmatism in an Island Arc from the Combined Data of Seismic Anelasticity and Velocity and Heat Flow," *Journal of Volcanology and Geothermal Research*, Vol. 51, No. 3, 1992, pp. 237-252. doi:10.1016/0377-0273(92)90125-W
- [3] K. Aki, " Attenuation of Shear Waves in the Lithosphere for Frequencies from 0.05 to 2 Hz," *Physics of the Earth and Planetary Interiors*, Vol. 21, 1980, pp. 50-60. doi:10.1016/0031-9201(80)90019-9
- [4] L. Knopoff, " Q," *Reviews of Geophysics*, Vol. 2, No. 4, 1964, pp. 625-660. doi:10.1029/RG002i004p00625
- [5] B. J. Mitchell, " Regional Variation and Frequency Dependence of QNL in the Crust of the United States," *Bulletin of the Seismological Society of America*, Vol. 71, 1981, pp. 1531-1538.
- [6] K. Aki, " Analysis of Seismic Coda of Local Earthquakes as Scattered Waves," *Journal of Geophysical Research*, Vol. 74, No. 2, 1969, pp. 615-631. doi:10.1029/JB074i002p00615
- [7] K. Aki and B. Chouet, " Origin of the Coda Waves: Source Attenuation and Scattering Effects,"

- [Open Special Issues](#)
- [Published Special Issues](#)
- [Special Issues Guideline](#)

[IJG Subscription](#)
[Most popular papers in IJG](#)
[About IJG News](#)
[Frequently Asked Questions](#)
[Recommend to Peers](#)
[Recommend to Library](#)
[Contact Us](#)

Downloads:	164,838
------------	---------

Visits:	392,858
---------	---------

[Sponsors, Associates, and Links >>](#)

- [8] R. Hermann, " Q Estimates Using Coda of Local Earth- quakes," Bulletin of the Seismological Society of America, Vol. 70, No. 2, 1980, pp. 447-468.
- [9] B. J. Mitchell, " Anelastic Structure and Evolution of the Continental Crust and Upper Mantle from Seismic Sur- face Wave Attenuation," Reviews of Geophysics, Vol. 33, No. 4, 1995, pp. 441-462. doi:10.1029/95RG02074
- [10] T. G. Rautian, V. I. Khalturin, V. G. Martynov and P. Molnar, " Preliminary Analysis of the Spectral Content of P and S-Waves from Local Earthquakes in the Garm, Tadjikista Region," Bulletin of the Seismological Society of America, Vol. 68, 1978, pp. 949-971.
- [11] K. Yoshimoto, H. Sato and M. Ohtake, " Frequency De- pendent Attenuation of P and S-Waves in the Kanto Area, Japan, Based on the Coda Normalization Method," Geophysical Journal International, Vol. 114, No. 1, 1993, pp. 165-174. doi:10.1111/j.1365-246X.1993.tb01476.x
- [12] S. W. Roecker, B. Tucker, J. King and D. Hatzfeld, " Estimates of Q in Central Asia as a Function of Frequency and Depth Using the Coda of Locally Recorded Earthquakes," Bulletin of the Seismological Society of America, Vol. 72, No. 1, 1982, pp. 129-149.
- [13] J. J. Pulli, " Attenuation in New England" , Bulletin of the Seismological Society of America, Vol. 74, No. 4, 1984, pp. 1149-1166.
- [14] S. Rhea, " Q Determined from Local Earthquakes in South Carolina Coastal Plain," Bulletin of the Seismological So- ciety of America, Vol. 74, No. 6, 1984, pp. 2257-2268.
- [15] J. M. Ibanez, E. Del Pezzo, F. De Miguel, M. Herraiz, G. Alguacil and J. Morales, " Depth Dependent Seismic Atte- nuation in the Granada Zone (Southern Spain)," Bulletin of the Seismological Society of America, Vol. 80, No. 5, 1990, pp. 1222-1234.
- [16] A. Akinci, A. G. Taktak and S. Ergintav, " Attenuation of Coda Waves in Western Anatolia," Physics of the Earth and Planetary Interiors, Vol. 87, No. 1-2, 1994, pp. 155- 165. doi:10.1016/0031-9201(94)90028-0
- [17] S. C. Gupta, V. N. Singh and A. Kumar, " Attenuation of Coda Waves in the Garhwal Himalaya, India," Physics of the Earth and Planetary Interiors, Vol. 87, No. 3-4, 1995, pp. 247-253. doi:10.1016/0031-9201(94)02968-H
- [18] J. Ni and M. Barazangi, " Seismotectonics of the Himalayan Collision Zone: Geometry of the Underthrusting Indian Plate beneath the Himalayas," Journal of Geophysical Research, Vol. 89, No. B2, 1984, pp. 1147-1163. doi:10.1029/JB089iB02p01147
- [19] P. Molnar, " A Review of the Seismicity and the Rates of Active under Thrusting and Deformation at the Hima- laya," Journal of Himalayan Geology, Vol. 1, No. 2, 1990, pp. 131-154.
- [20] P. Molnar, B. E. Tucker and J. N. Brune, " Corner Frequencies of P- and S-Waves and Models of Earthquake Sources," Bulletin of the Seismological Society of America, Vol. 63, No. 6, 1973, pp. 2091-2104.
- [21] Y. Zeng, F. Su and K. Aki, " Scattered Wave Energy Pro- pagation in a Random Isotropic Scattering Medium, I. Theory," Journal of Geophysical Research, Vol. 96, No. B1, 1991, pp. 607-619. doi:10.1029/90JB02012
- [22] A. Frankel, " Mechanisms of Seismic Attenuation in the Crust: Scattering and Anelasticity in New York State, South Africa, and Southern California," Journal of Geophysical Research, Vol. 96, 1991, pp. 6269-6289. doi:10.1029/91JB00192
- [23] G. Sarkar and A. Abers, " Comparison of Seismic Body Wave and Coda Wave Measures of Q," Pure and Applied Geophysics, Vol. 153, No. 2-4, 1998, pp. 665-683. doi:10.1007/s000240050213
- [24] M. Hoshiba, " Simulation of Multiple Scattered Coda Wave Excitation Based on the Energy Conservation Law," Phy- sics of the Earth and Planetary Interior, Vol. 67, No. 1-2, 1991, pp. 123-136. doi:10.1016/0031-9201(91)90066-Q
- [25] M. N. Toksoz, A. H. Johnston and A. Timur, " Attenuation of Seismic Waves in Dry and Saturated Rocks-I La- boratory Measurements," Geophysics, Vol. 44, No. 1, 1979, pp. 681-690. doi:10.1190/1.1440969

- [26] S. Mochizuki, " Attenuation in Partially Saturated Rocks," Journal of Geophysical Research, Vol. 87, No. B10, 1982, pp. 8598-8604. doi:10.1029/JB087iB10p08598
- [27] K. W. Winkler and A. Nur, " Seismic Attenuation Effects of Pore Fluids and Frictional Sliding," Geophysics, Vol. 47, No. 1, 1982, pp. 1-15. doi:10.1190/1.1441276
- [28] M. Vassiliou, C. A. Salvado and B. R. Tittmann, " Seismic Attenuation," In: R. S. Carmichael, Ed., CRC Handbook of Physical Properties of Rocks, Vol. 3, CRC Press, Boca Raton, 1982.
- [29] D. H. Johnston, M. N. Toksoz and A. Timur, " Attenuation of Seismic Waves in Dry and Saturated Rocks: I," Mechanics in Geophysics, Vol. 44, 1979, pp. 691-711. doi:10.1190/1.1440970