Abstract

Seismic attenuation plays a significant role in characterizing the lithospheric structure and tectonic interpretations. It is also essential for seismic hazard assessment. Moreover, it is an indirect measurement of crustal temperature and rheology. Attenuation (Q) structure enlightens the complexity in the crust, related to the strength and weakness, crucial for understanding the earthquake genesis of an area. Attenuation is mainly controlled by two mechanisms: intrinsic phenomenon which is caused due to the fluid, temperature, partial melting etc. and scattering effect which is associated with the heterogeneities present in the medium. In the present study I have aimed to provide laterally varying Q models for western Tibet Plateau and its surrounding areas, which include the Songpan-Ganzi complex, the Tianshuihai, the Qiangtang, the Lhasa, and the Himalayas using the regional waves Lg and Pg. The area is tectonically very active but least explored compared to the eastern part. This study probably provides the first high resolution regional wave (Lg and Pg) attenuation tomographic images for the western Tibet and surrounding regions.

At first, LgQ model at 1 Hz (LgQ_0) is obtained using 282 earthquakes with magnitude greater than 4.6 m_b and focal depth less than 50 km that are recorded at 48 seismic stations operated across western Kunlun and western Tibet. A total of 706 Two-station method (TSM) and 533 Reverse two-station method ($RTSM$) pairs are generated further to produce a Q tomography image with grid-size $0.5^\circ X 0.5^\circ$ using the least-squares orthogonal factor decomposition ($LSQR$) algorithm. The results provide new insights into the attenuation properties of the crust and its linkage with regional geodynamics. The low $LgQ_0 < 50$ values are observed in TSM image along the Kunlun Suture, Tianshuihai terrane and in some pockets

of the north western side of the Lhasa terrane. The high $LgQ_0 > 200$ is revealed in the central part of Lhasa terrane in western Tibet from both TSM and $RTSM$ images. The high LgQ_0 values complemented with the high P_n velocities beneath the central part of Lhasa terrane may indicate the trace of underthrusting Indian lithosphere beneath the western Tibet.

Subsequently, Pg attenuation tomography image is produced at 1 Hz (PgQ_0) using 735 TSM and 561 $RTSM$ pairs. Both TSM and $RTSM$ models exhibit spatial variations with a predominance of low Q structure. The northern part such as Kunlun suture and Tianshuihai terrane belong to high attenuation zones consistent with the observed low LgQ_0 values. This segment has active tectonics caused by several geological units. It is seismically very active and has been the center of several historical earthquakes in the recent past. Therefore, the high attenuation can be linked to the earthquake genesis in this area. The Lhasa terrane is mostly dominated by moderate PgQ_0 values, with very few pockets of high Q structures evident in both TSM and $RTSM$ images, which is relatively dissimilar from the reported LgQ values. This could be attributed to the presence of strong crustal heterogeneity as a result of the underthrusting of the Indian lithosphere beneath western Tibet. I have also made a comparison study between the obtained PgQ_0 and the LgQ_0 anomalies as well as with the geology for both the TSM and $RTSM$ images along different cross-sections across the diverse tectonic structures within the crust of the Lhasa terrane. The average value of PgQ_0 is relatively lower than the LgQ_0 values though the overall pattern is quite consistent along all the profiles. No significant correlations are observed with the geology.

The frequency dependent behaviour of both Lg and Pg are further studied for a frequency band 0.2-0.6, 0.4-1.2 and 0.8-2.4 Hz at central frequencies of 0.4 Hz, 0.8 Hz and 1.6 Hz respectively implementing both TSM and $RTSM$. The $RTSM$ has a more restrictive geometry than the TSM image which causes no ray path coverage in the northern side of our study area. The amplitudes of both the waves are fundamentally sensitive to the crustal properties and structures and are mainly controlled by both scattering and

intrinsic attenuation. The LgQ images exhibit a frequency dependent nature which is consistent with the characteristics of the PgQ model for the region. The northern part which is consisted of several faults such as strike-slip Karakax Fault, western Kunlun Shan thrust system, etc. exhibit a consistent low Q at all frequencies, which may be attributed to the predominant intrinsic attenuation due to the partial melting, high temperature or channel flow in the crust. A moderate to high Q values are evident in Lhasa terrane could supplement the trace of underthrusting Indian lithosphere beneath the region. Overall, average Q values for both Lg and Pg increase with increasing frequency. The frequency dependent parameter η shows a quite low value for both the waves using TSM and $RTSM$ may have arisen due to the limited frequency range selected in the present study.