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Body wave seismic attenuation tomography of the crust in the Sichuan-Yunnan Region, China

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The Sichuan-Yunnan Region is located at the southeastern margin of the Tibetan plateau in southwest China. Determining the structure of southeaster margin of the Tibetan plateau is very important for understanding the eastward growth of the plateau. At present, most of seismic tomography studies are focused on resolving multiscale velocity anomalies of the crust and mantle. However, seismic attenuation structure of the crust and upper mantle in the Sichuan-Yunnan Region is less studied, which can be used to better understand the temperature regime and the distribution of partial melting. In this study, based on a high-resolution community velocity model of the crust and uppermost mantle in this area (Liu et al., 2021), we determined body wave attenuation structure in the Sichuan-Yunnan region using data from 350 stations and 9837 seismic events observed between 2010 and 2013 (Figure 1).

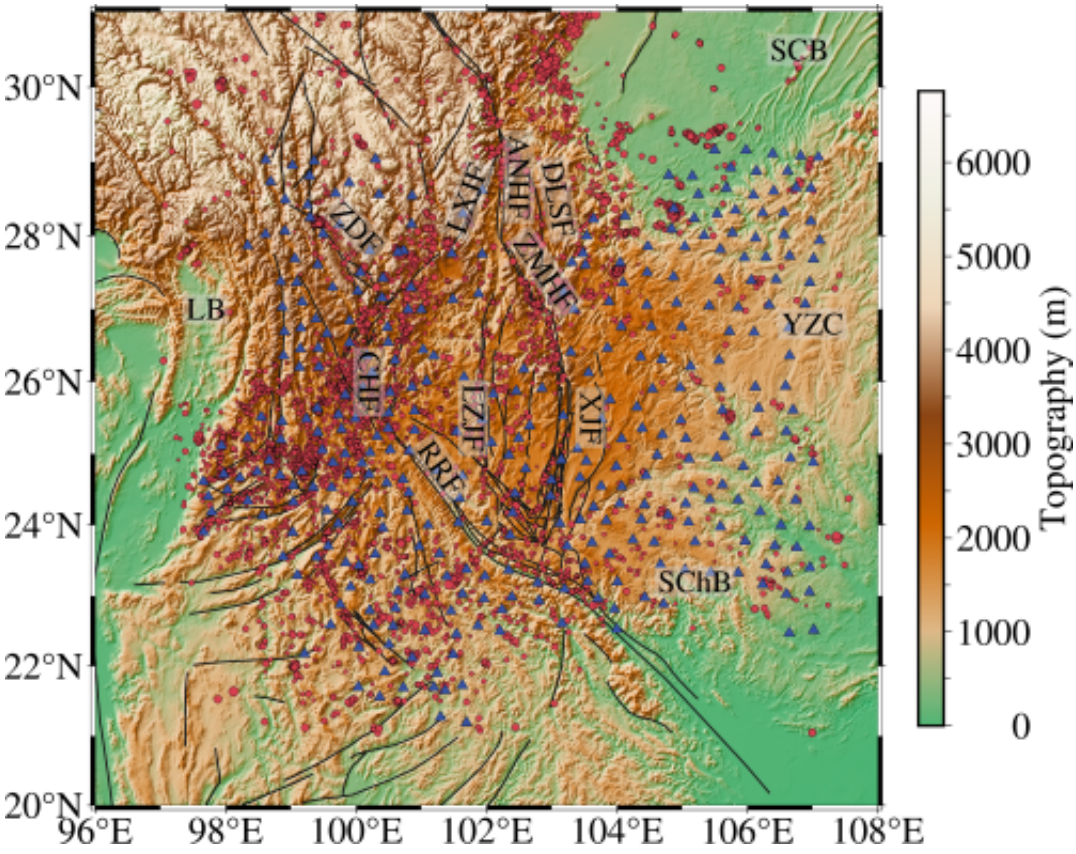

Figure 1. Distribution of seismic events (red circles) and stations (blue triangles) in the Sichuan-Yunnan region.

Q value is a reduction to a dimensionless form of the more usual measures of attenuation (Knopoff, 1964. Body wave attenuation tomography typically needs to extract a parameter called t* from the displacement or velocity spectrum in the frequency domain to calculate Q using the following equation:

$$\ln\left(A_{ij}^{corr}(f)\right) = \ln\left(\Omega_{O_{ij}}\right) - \ln\left(1+\left(\frac{f}{f_i^c}\right)^2\right) + \ln\left(S_j(f)\right) - \pi f t_{ij}^*$$

Here the influence of frequency on Q was not considered. Using the measured absolute t* values, the attenuation structure was then determined with the following relationship between t* and Q:

$$t^* = \int_S \frac{1}{Q(x,y,z)} \frac{1}{V(x,y,z)} ds$$

For the Sichuan-Yunnan region, we constructed three-dimensional Qp and Qs models with a horizontal spatial grid interval of 0.4° × 0.4°. Our attenuation models exhibit a high consistency with large-scale features in previous researches. In the shallow depths (<20 km), inside the Chuan-Dian diamond block, it exhibits high Q anomalies, which may be related to the high density and low porosity characteristics of the Emeishan Large Igneous Province (ELIP). Previous studies suggest the presence of high Vp and Vs anomalies in the same zone (Liu et al., 2021). In comparison, most of the fault zones show low Q anomalies, indicating that fractures and fluids in

the crust can increase the attenuation of seismic waves. At deeper depths (20-40 km), the ELIP still maintains a high Q anomaly, and separates two clear stripes of low Q anomalies along the Lijiang-Xiaojinhe Fault and Xiaojiang Fault. This suggests the existence of partial melting along the two fault zones that could be caused by upwelling of hot mantle materials. In addition, high Q values are observed in the Yangtze craton and Sichuan Basin, corresponding to stable tectonic block and weak tectonic activity.