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Correlation between Crustal Azimuthal Anisotropy and the Zhangjiakou-Penglai Fault Zone

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Abstract: To characterize crustal azimuthal anisotropy in the Zhangjiakou-Penglai Fault Zone, we apply a recently-developed deconvolution approach to effectively remove near-surface reverberations in the receiver functions recorded at 64 broadband seismic stations. We subsequently determine the fast orientation (φ) and the magnitude of crustal anisotropy (δt) by fitting the sinusoidal moveout of the P to S converted phases from the Moho. The δt is found to range from 0.1 s to 0.54 s, with an average of 0.28±0.09 s. Fault-parallel anisotropy in the seismically active Zhangjiakou-Penglai Fault Zone is most likely related to the fluid-filled fractures, and the results in the fault zone support the existence of a broad shear zone at depth. Historical strong earthquakes mainly occurred in the segments of the fault zone with significant crustal anisotropy, suggesting that the measured crustal anisotropy is closely related to the degree of crustal deformation. The observed spatial distribution of crustal anisotropy suggests that the Zhangjiakou-Penglai Fault Zone has limited influence on the interior of the stable western North China Craton and the northwestern terminus of the fault zone probably ends at about 114° E.

Key words: Zhangjiakou-Penglai Fault Zone, seismic anisotropy, receiver function, crustal deformation

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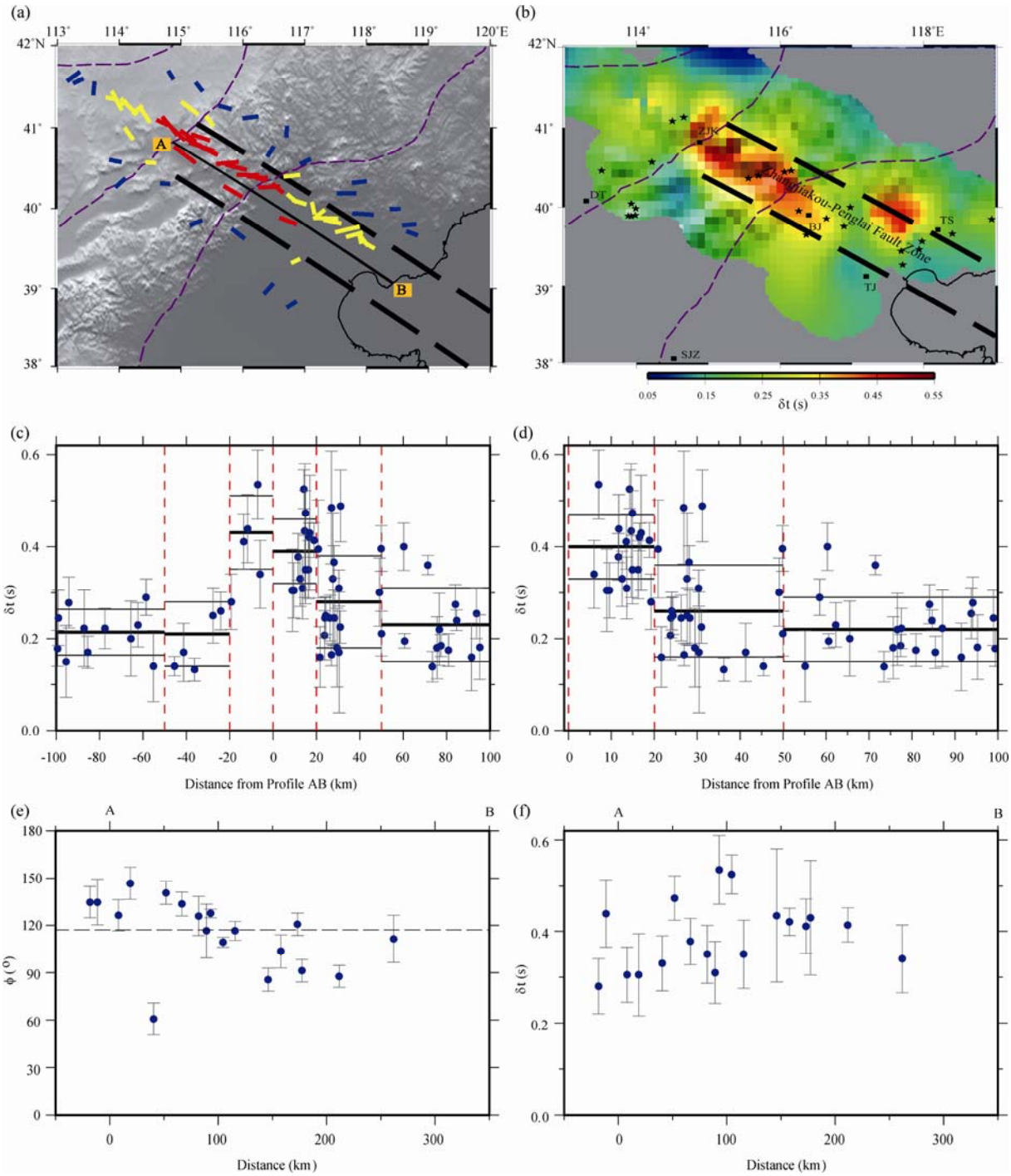

Fig. 1. Crustal anisotropy measurements in the Zhangjiakou-Penglai Fault Zone and adjacent areas.

(a) Red bars, yellow bars, and blue bars correspond to the measurements that are perpendicular to the center of the fault zone (the solid black line labeled as Profile AB) within 20 km, between 20 and 50 km, and between 50 and 100 km, respectively. The length and orientation of the bars denote the δt and φ measurements, respectively; (b) Spatial distributions of the δt measurements. The black stars denote M ≥ 6.0 earthquakes since the 23th century BC. The black squares mark the locations of cities; (c) The δt observations (blue dots) at stations that are perpendicular to Profile AB within 100 km. Thick and thin horizontal black bars denote the mean value and standard deviation, respectively; (d) Same as (c) but the observations are plotted against the absolute distance from Profile AB; (e) The φ measurements observed at stations within 20 km from Profile AB plotted against the distance from Point A. The dashed black line is the approximate strike of the Zhangjiakou-Penglai Fault Zone; (f) The same as (e) but for the δt observations. BJ, Beijing; DT, Datong; SJZ, Shijiazhuang; TS, Tangshan; TJ, Tianjin; ZJK, Zhangjiakou.