SH wave structure of the crust and upper mantle in southeastern margin of the Tibetan Plateau from teleseismic Love wave tomography

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Introduction

Regional investigation of the lithospheric structure in southeastern margin of the Tibetan Plateau dates back over 25 yr, since it is a unique place to study the interaction between the collision of the Burma microplate and Eurasian plate and the eastward or southeastward extrusion of material from the central and eastern part of the plateau (Figure 1). Large difference of velocity distribution exists among these studies. More information is needed to constrain the velocity structure. Previous surface wave tomography have concentrated exclusively on Rayleigh wave. Love wave can provide independent information about the subsurface structure. With the completion of the ChinArray in this region, phase velocity maps of Love wave with high resolution can be developed to better constrain the structure in the crust and uppermost mantle for the southeastern Tibet. In this study, we obtain the SH velocity with high resolution for the first time. This new model will provide useful information to estimate the radial anisotropy and to constrain the deformation mechanism.

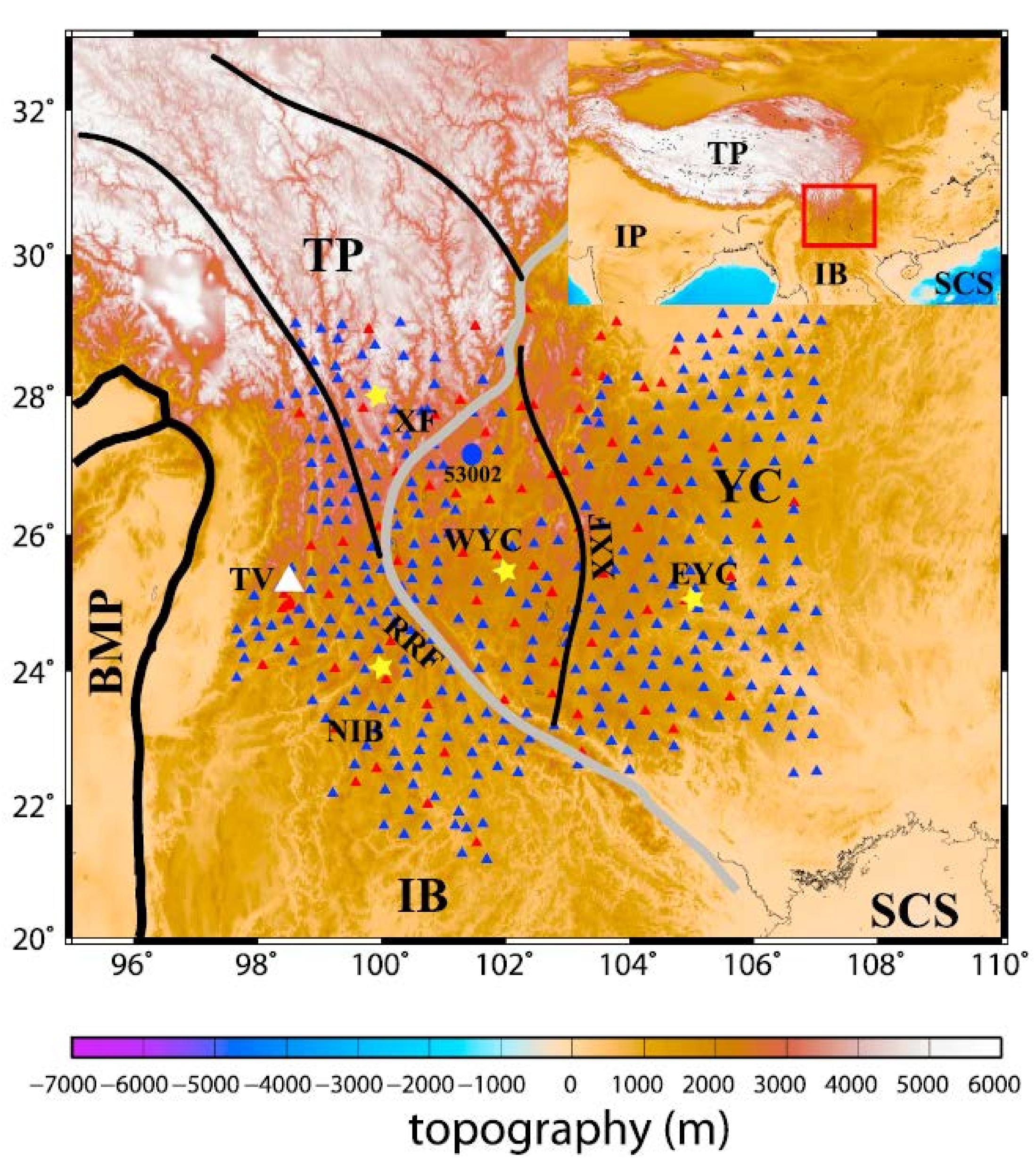

Fig. 1 Map showing tectonic features and seismic stations in the southeastern Tibetan Plateau. The broadband stations from the temporary ChinArray and the permanent China Digital Seismic Array are indicated by blue and red triangles, respectively. The large white triangle marks the Tengchong Volcano (TV). The blue circle is station 53202. Yellow stars mark the locations for phase velocities shown in Figure 9. The gray line indicates the boundary between the Tibetan Plateau and Yangtze Craton. IP, Indian Plate; TP, Tibetan Plateau; BMP, Burma microplate: IB, Indochina Block; YC, Yangtze Craton; SCS, South China Sea; NiB, northern Indochina Block; WYC, western Yangtze Craton; EYC, eastern Yangtze Craton; RRF, Red River Fault; XF, Xiaojinhe Fault; and XXF, Xianshuihe-Xiaojiang Fault

Data and Method

- Love wave phase velocity data at periods of 20-100 s
- Non-linear inversion of SH wave velocity using the method of Saito (1988)

SH wave velocity

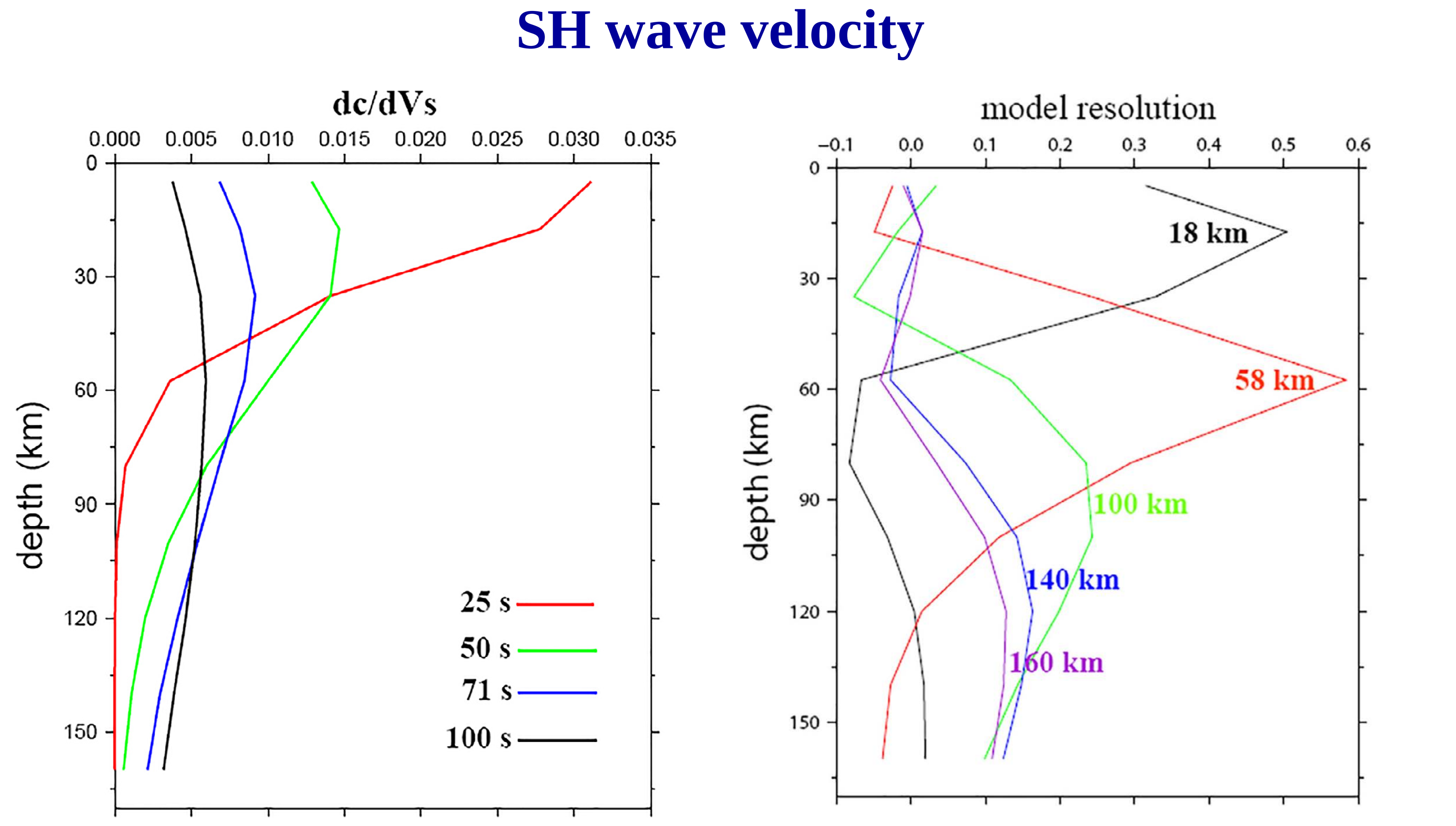

Fig. 2 (left) Love wave sensitivity kernels for shear wave at periods of 25, 50, 71, and 100 s. The kernels are calculated based on the velocity model AK135 using the method of Saito. (right) Resolution kernels of shear wave velocity from the resolution matrix for the reference model at five layers with median depths at 18, 58, 100, 140, and 160 km.

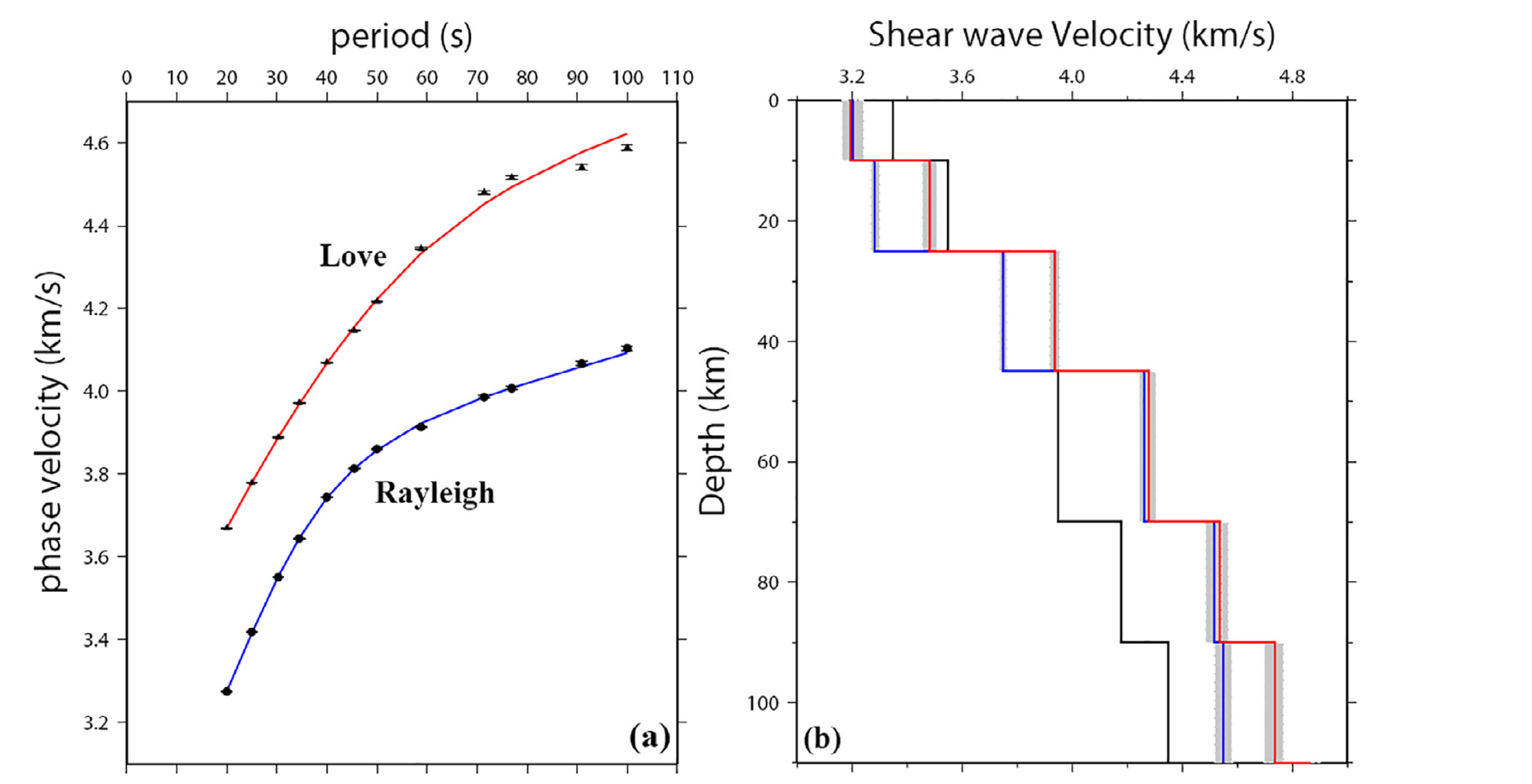

Fig. 3 Love wave average dispersion curve and associated best fitting model (red). The correspondent results of Rayleigh wave (blue) are from Fu et al. (2017) for comparison. (a) Observed (dots) and predicted (lines) dispersions from the best fitting model. Error bars represent two standard deviations. (b) Shear wave models . The black line represents a modified AK135 model used as an initial model in the inversion. The width of the shaded area shows the standard error of isotropic shear wave velocity in each layer.

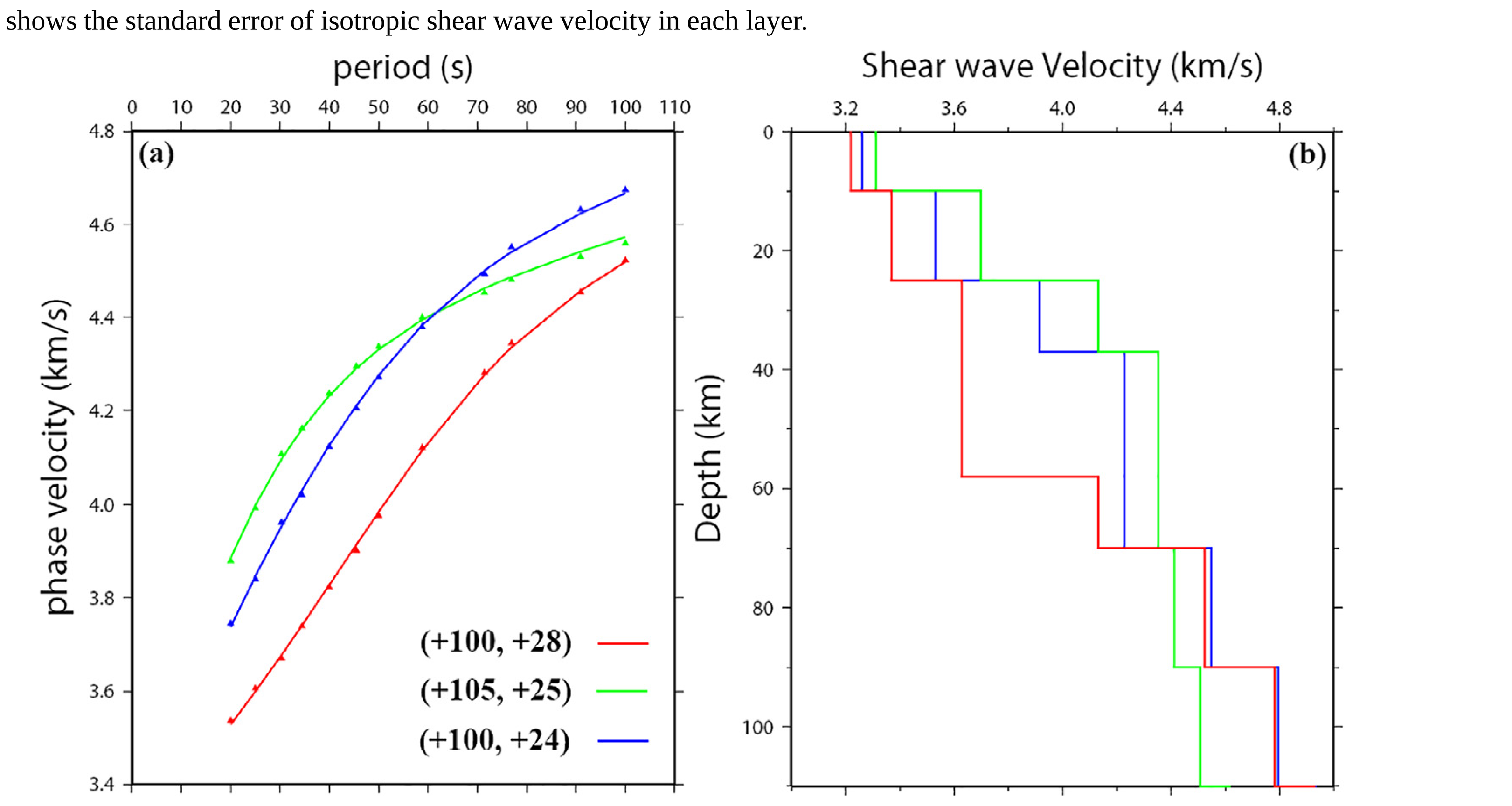

Fig. 4 (a) Observed (triangles) and predicted Love wave phase velocities and (b) associated best fitting models at the grid points that are shown in Figure 1 (yellow stars).

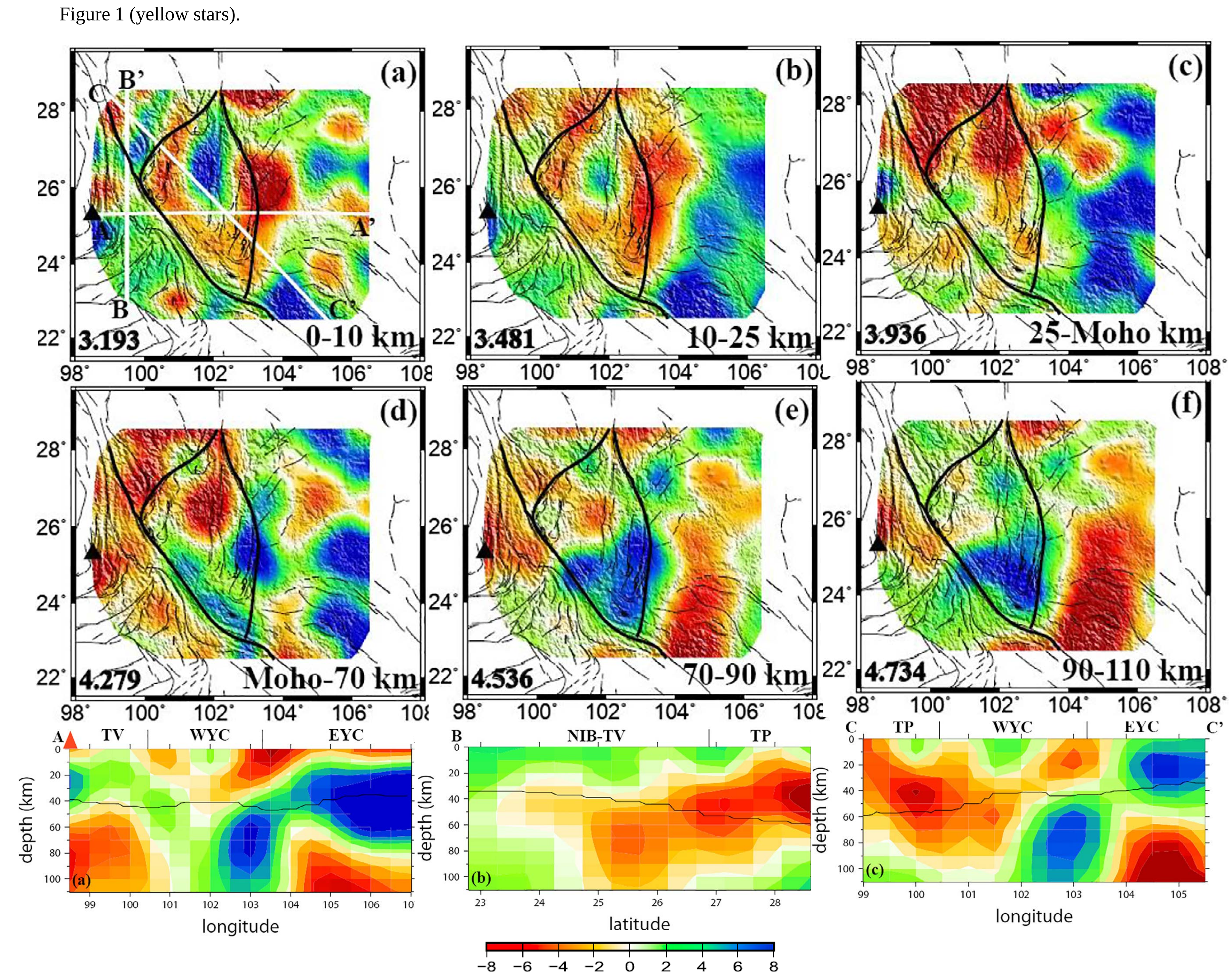

Fig. 5 Maps and cross-sections of shear wave velocity perturbation in the crust and upper mantle. The velocity perturbations is relative to the average value of each layer indicated in the lower left corner of each map.

Summary

- Strong low SH wave velocity anomalies with various geometry at different depths in the crust are imaged in the Tibetan Plateau. This variation from channel-like at shallow depths to a broadened pattern in the lower crust could suggest that the crustal deformation is dominated by block rotation in the upper part and ductile flow in the lower part.
- The high SH wave velocity anomaly and low SV wave below 70 km depth in the northern Indochina block imply the existence of positive radial anisotropy, reflecting horizontal layering of anisotropic materials due to the past and recent rifting activities associated with the slab rollback along the Sumatra-Andaman Sea subduction zone.

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