3-D Velocity Structure of the Crust and upper Mantle in Tibet and its Geodynamic Effect

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The crust and upper mantle structure under Tibet is the direct result of the India plate subducting and colliding with the Eurasian plate. 3-D seismic velocity structure of the crust and upper mantle under Tibet was determined by using the Tomo3D tomography program developed by Prof. Dapeng Zhao (Zhao et al. 1992, 1994). In the tomographic inversion we used 139,021 P-wave arrival times from 9649 teleseismic events recorded by 305 seismic stations. The major results of this study (Zheng 2006) are summarized as follows:

1) The Tibetan crust velocity structure is generally consistent with the surface tectonic features which are oriented nearly east-west. But the main trend of the velocity anomalies in the upper mantle is generally oriented in the north-south direction. The location of the NNE strike low-velocity zone is consistent with the N-S strike negative aeromagnetic data.

2) Low-velocity anomalies in the crust are clearly visible under the Himalaya Mountain.

3) Our tomographic images show that the Indian lithospheric mantle subducting angles are different under different areas, but their front locations are all beneath the Qiangtang terrain. The tomographic images (Figure 1) along 88°E show that the Indian lithospheric mantle is underthrusting northwards with a dip angle of about 22° beneath the center of Qiangtang terrane at about 34°N latitude, and its frontier has reached to the deep part of the upper mantle. The tomographic images along North-East profile show that the Indian mantle has nearly horizontally underthrusted under the Tibet from Ganges plain to 33°N. Then, the Indian mantle broke off down to the asthenosphere and caused the asthenophere upwelling. The top shows the surface topography. The tectonic lines are the same as those in Figure 1. The middle panel shows tomography. White circles show local earthquake hypocenters. The dash lines indicate the estimated upper and lower boundaries of the subducting Indian lithospheric mantle. The low-left panel shows the P-wave velocity perturbation scale. The low-right panel shows the location of profile AB along 88° E.

4) There is a huge low-velocity body (Wittlinger et al.,1996) which looks like a mantle plume beneath the Qiangtang terrain. Such a prominent low-velocity body is impossible to be the partial melting products. It is speculated to be either the subducted delamination of the Indian lithospheric mantle according to its location and extending depth with Qaidam block holding back the thermal disturbance in the area, and so resulting in higher temperature which begets falling velocity or be the mantle upwelling materials along the surface of Indian lithospheric mantle.

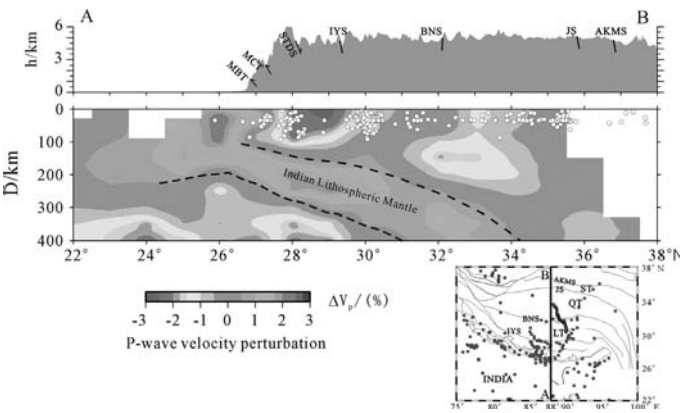

FIGURE 1. P-wave tomographic image of the subducting Indian lithospheric mantle along profile AB.

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