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Lateral Variation in Crustal Structure of the Northern Tibetan Plateau Inferred from Teleseismic Receiver Functions

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Abstract. We investigate lateral variations in crustal structure across the northern boundary of the Tibetan Plateau using the receiver functions at three broadband stations deployed during the 1991-1992 Tibet PASSCAL experiment. The first 5 s of the receiver functions vary systematically with backazimuth: the radial receiver functions are symmetric across the N-S axis while the tangential receiver functions are anti-symmetric across this axis. This symmetry can be modeled by E-W striking dipping interfaces in the upper-middle crust. The strike direction is consistent with the E-W trend of surface geology. Modeling a P-to-S converted phase in the receiver functions at each station suggests that there is a mid-crustal low-velocity layer with its upper boundary dipping 20° to 30° to the south. In addition, a shallow northwards-dipping interface is responsible for the "double-peaked" direct P arrivals in the radial receiver functions and large tangential motions at one of the stations. The low-velocity layer, together with other geological and seismological observations, suggests that there is a hot, possibly partial melt zone in the middle crust of northern Tibet. Alternately, dipping velocity interfaces might be associated with some buried thrust faults in the upper crust which accommodated crust shortening during the plateau formation.

Introduction

The Tibetan Plateau, bounded by the Kunlun mountains in the north and Himalayas in the south, with an average elevation of 5 km and an areal extent of nearly $7 \times 10^5 km^2$, has long been an interesting and challenging subject in the Geosciences. The uplift of Tibetan Plateau is the result of the collision of the Indian plate with Eurasia which began during Middle Eocene, 45 million years ago. However, the details of the uplift mechanism remain controversial. Among the most popular uplift models are the underthrust model and its variants [*Argand*, 1924; *Zhao and Morgan*, 1985; *Beghoul et al.*, 1993], the crustal shortening and thickening model [*Dewey and Bird*, 1970; *Dewey and Burke*, 1973], and the lateral crustal extrusion model [*Molnar and Tapponnier*, 1977; *Tapponnier et al.*, 1982]. Due to insufficient information on the lithospheric structure of the plateau, it is difficult to discriminate among different uplift models.

Most geological and geophysical investigations on the plateau have been concentrated on the southern Tibet, near the Himalayas. Comparatively, the structure near the northern boundary of the plateau was poorly resolved. Recently, in a joint research project conducted by the Institute of Geophysics, State Seismological Bureau, China, the University of South Carolina, and the State University of New York at Binghamton, 11 broadband three-component seismic recorders were deployed