Configuration of the Indian Moho beneath the NW Himalaya and Ladakh

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[1] Teleseismic receiver function analysis of seismograms recorded on a ~700 km long profile of 17 broadband seismographs traversing the NW Himalaya shows a progressive northward deepening of the Indian Moho from ~40 km beneath Delhi south of the Himalayan foredeep to ~75 km beneath Taksha at the Karakoram Fault. Similar studies by Wittlinger et al. (2004) to the north of the Karakoram Fault show that the Moho continues to deepen to ~90 km beneath western Tibet before shallowing substantially to 50–60 km at the Altyn Tagh Fault. The continuity of the Indian Moho imaged in the receiver functions reported here, along with those of Wittlinger et al. (2004), suggest that in this part of the Himalayan orogen the Indian plate may penetrate as far as the Bangong Suture, and possibly as far north as the Altyn Tagh. **Citation:** Rai, S. S., K. Priestley, V. K. Gaur, S. Mitra, M. P. Singh, and M. Searle (2006), Configuration of the Indian Moho beneath the NW Himalaya and Ladakh, *Geophys. Res. Lett.*, *33*, L15308, doi:10.1029/2006GL026076.

1. Introduction

[2] While it is now clear that the Indian crust, albeit with its upper parts sheared and stacked as thrust sheets forming the Himalaya Mountains, underlies the eastern Himalaya and southeastern Tibet [*Mitra et al.*, 2005], it is uncertain how far the Indian crust penetrates the northwestern Himalaya. Analysis of paleomagnetic data [*Klootwijk et al.*, 1985] suggests that the collision of India with the accreted southern margin of Asia first started in the west ~55 Ma and then moved progressively eastward over the next few million years involving a counter-clockwise rotation of India and a dramatic reduction of its northward velocity. The existence of deep (70–90 km) earthquakes beneath western Tibet [*Jackson et al.*, 2004] may imply penetration of the Indian plate at least as far north as the Karakoram. However, the relatively more rugged trans-Himalayan topography of the northwestern Himalayan arc compared with the more subdued topography of the eastern arc suggests possible differences in the rigidity of the two regions and that the penetration of India beneath the Himalaya and southern Tibet may not have operated uniformly across the entire arc. Resolving this issue requires better knowledge of the structure of the Indian plate beneath the western arc, knowledge which has wider implications for our understanding of the rheology and deformation mechanisms of the continental lithosphere. In this paper we present an image of the Moho beneath the NW Himalaya and Ladakh, the region which contains the highest average elevations of the Himalaya Range and the narrowest and highest part of the Tibetan Plateau.

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2. Field Experiment and Analysis

[3] We operated 15 broadband seismographs from September 2002 to September 2003 along a profile extending from the Gangetic plain northward across the Himalaya to the southwestern flank of the Karakoram in Ladakh (Figure 1). Each station consists of a Guralp CMG3T or CMG3esp sensor with a flat velocity response between 0.0083 and 50 Hz, and a Refraction Technology data logger. Data were continuously recorded at 20 samples/s and time-stamped using a GPS receiver. These temporary stations and the permanent seismographs operating at Delhi (NDI) by the Indian Meteorological Department and at Hanle (HNL) by the Indian Institute of Astrophysics and the University of Cambridge, both of which have similar instrumentation, provide the data for this study.

[4] We analyse P-wave receiver functions [*Langston*, 1979] to determine the Moho configuration along the profile by jointly inverting receiver functions with fundamental mode group velocity data. Receiver functions were calculated for all M $\geq$ 5.7 events recorded in the 30°–90° distance range using the iterative, time domain deconvolution method [*Ligorria and Ammon*, 1999].

3. Observations

[5] To track the Moho Ps conversion as the Indian Plate penetrates the Himalaya and western Tibet, we plot individual and summed radial receiver functions for each station (Figure 2). These were computed with a Gaussian lowpass filter with a corner at 0.7 Hz, and corrected for distance moveout of the Moho Ps phase to a reference distance of 67°. Distances in the plots are measured along the N-S azimuth of the profile which is along the trend of the stations whose locations were dictated by the limited access in the region, even though the natural grain of the tectonic fabric at this longitude is oriented more NW-SE. The average of the summed receiver functions is plotted in the left panel (Figures 2a and 2c); the individual receiver functions are plotted equispaced in the right panel (Figures 2b and 2d).