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A Moho ramp imaged beneath the High Himalaya in Garhwal, India

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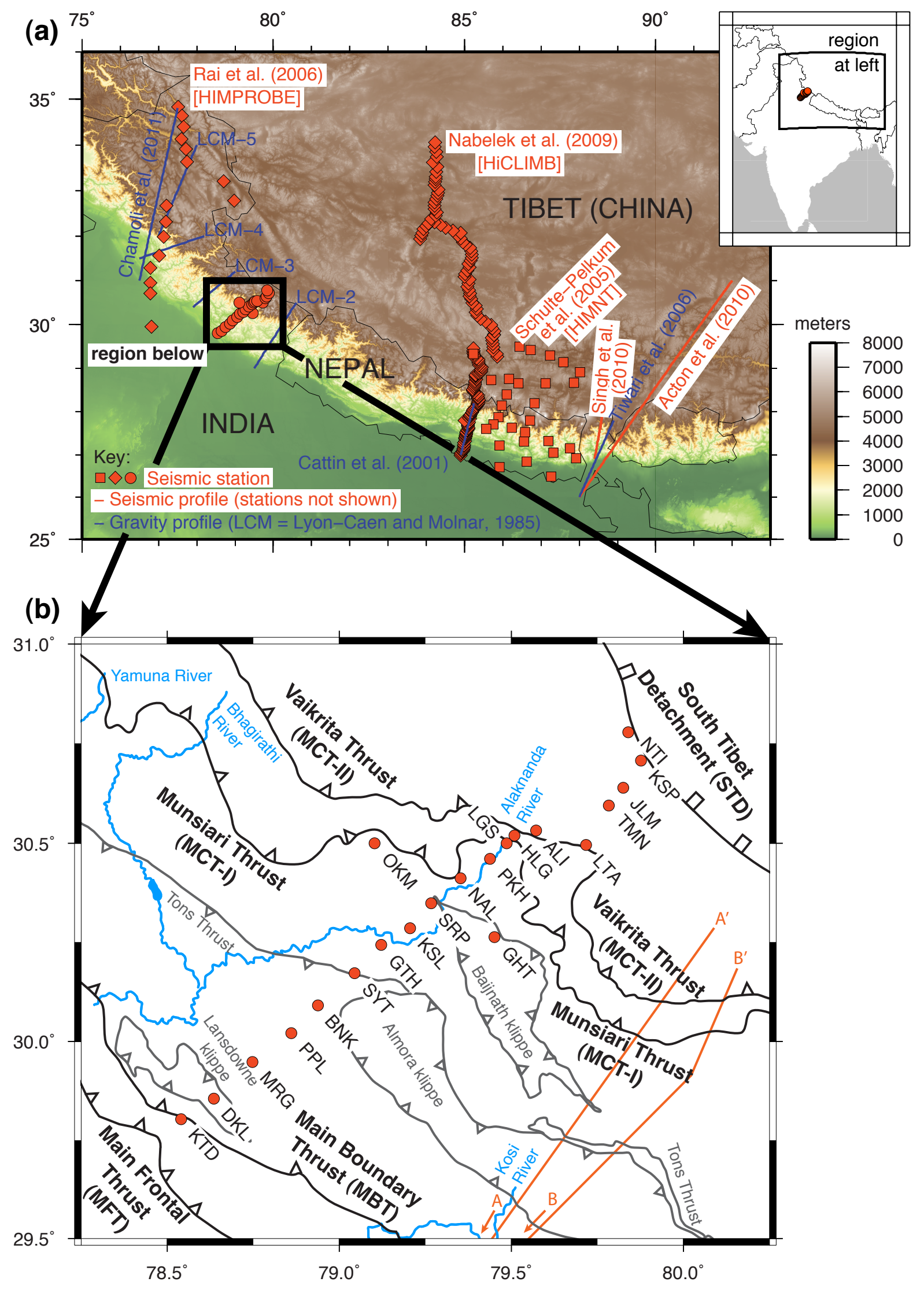
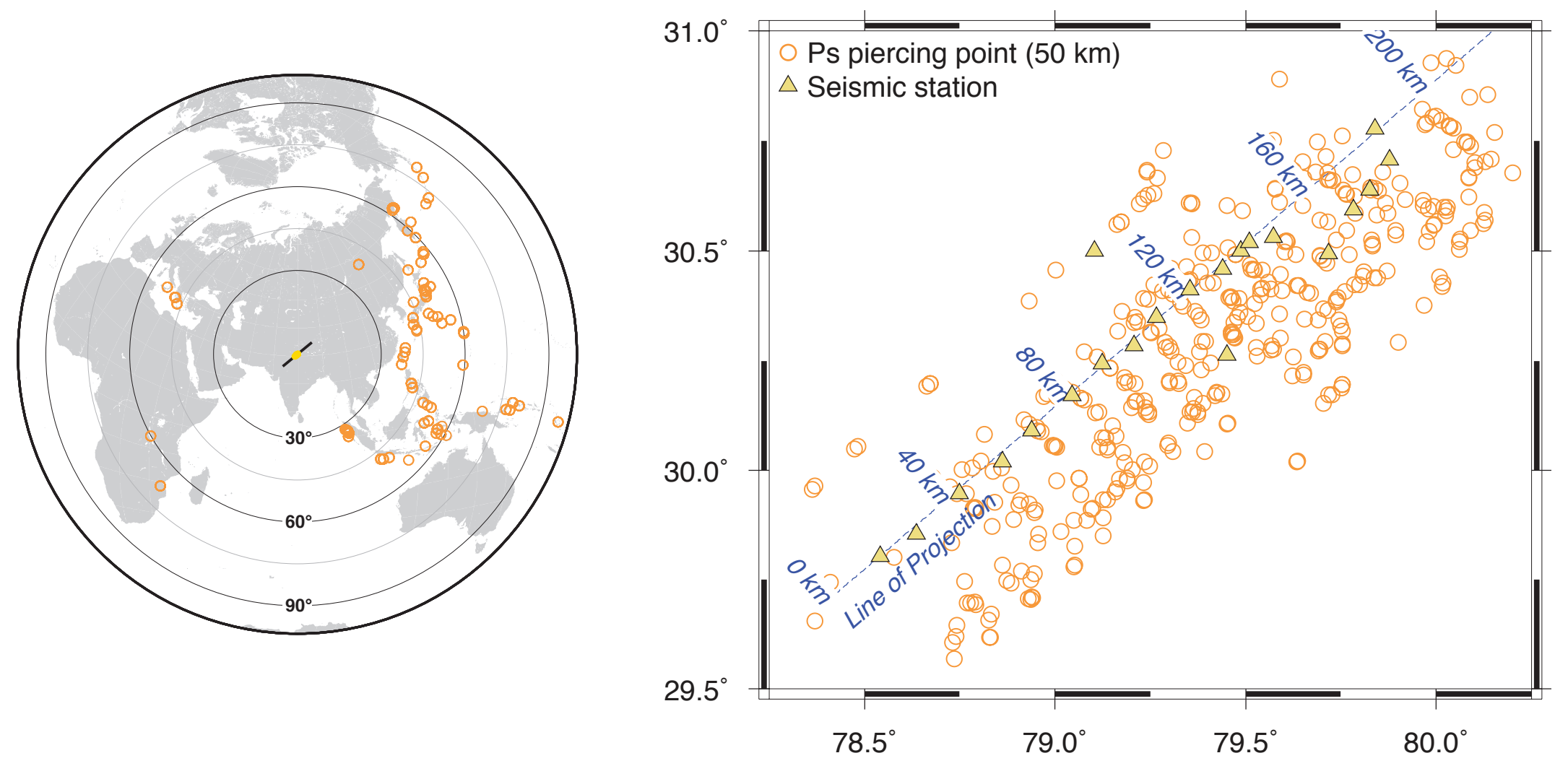
1. Location of study:



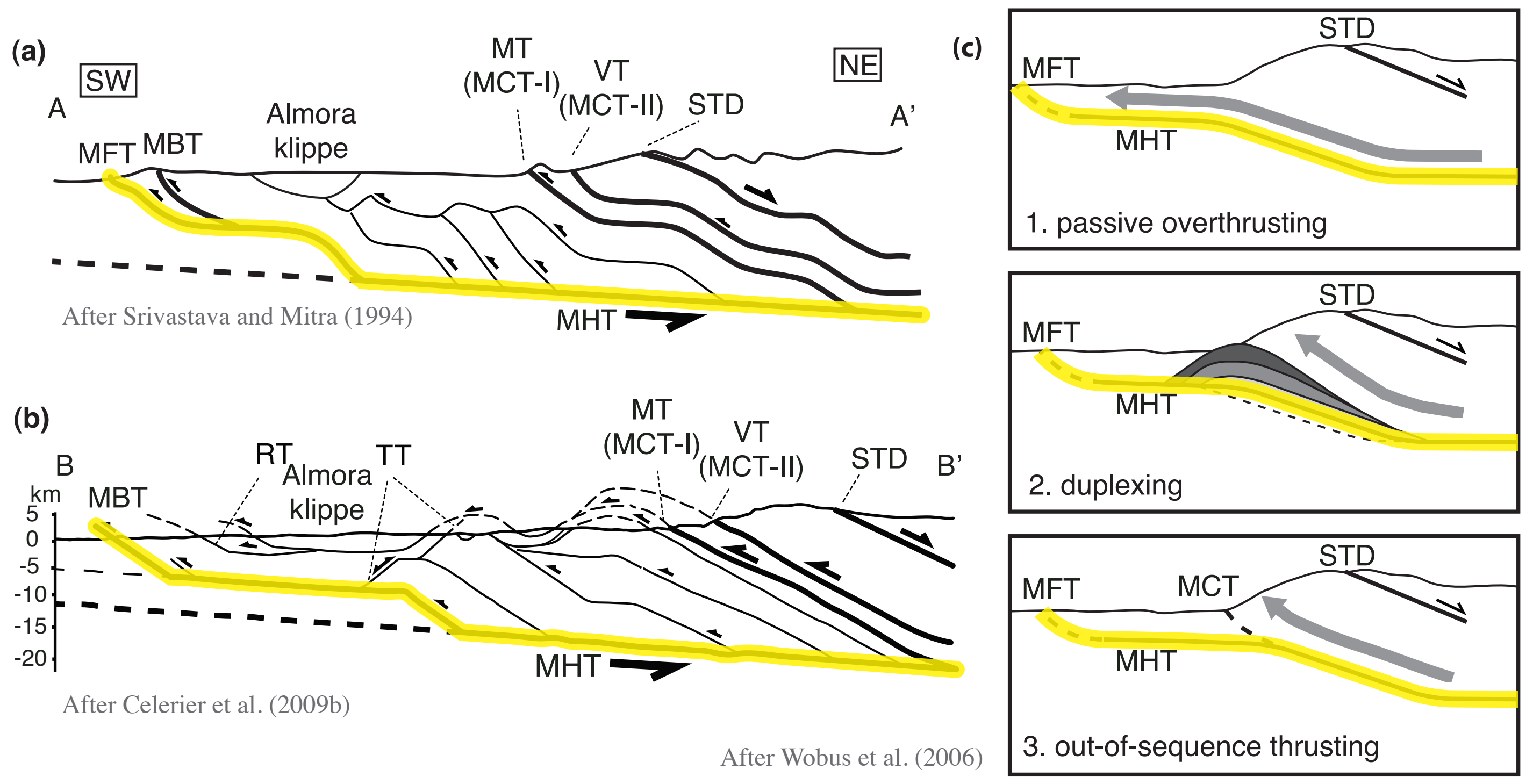
NGRI deployed 21 broadband seismic stations in the western Himalaya in 2005-2006.

2. Events used:

The array recorded 450 teleseismic earthquakes of $M_w > 5.5$ and epicentral distance 30-90°, of which 85 were suitable for receiver function (RF) analysis.



3. Structural setting:

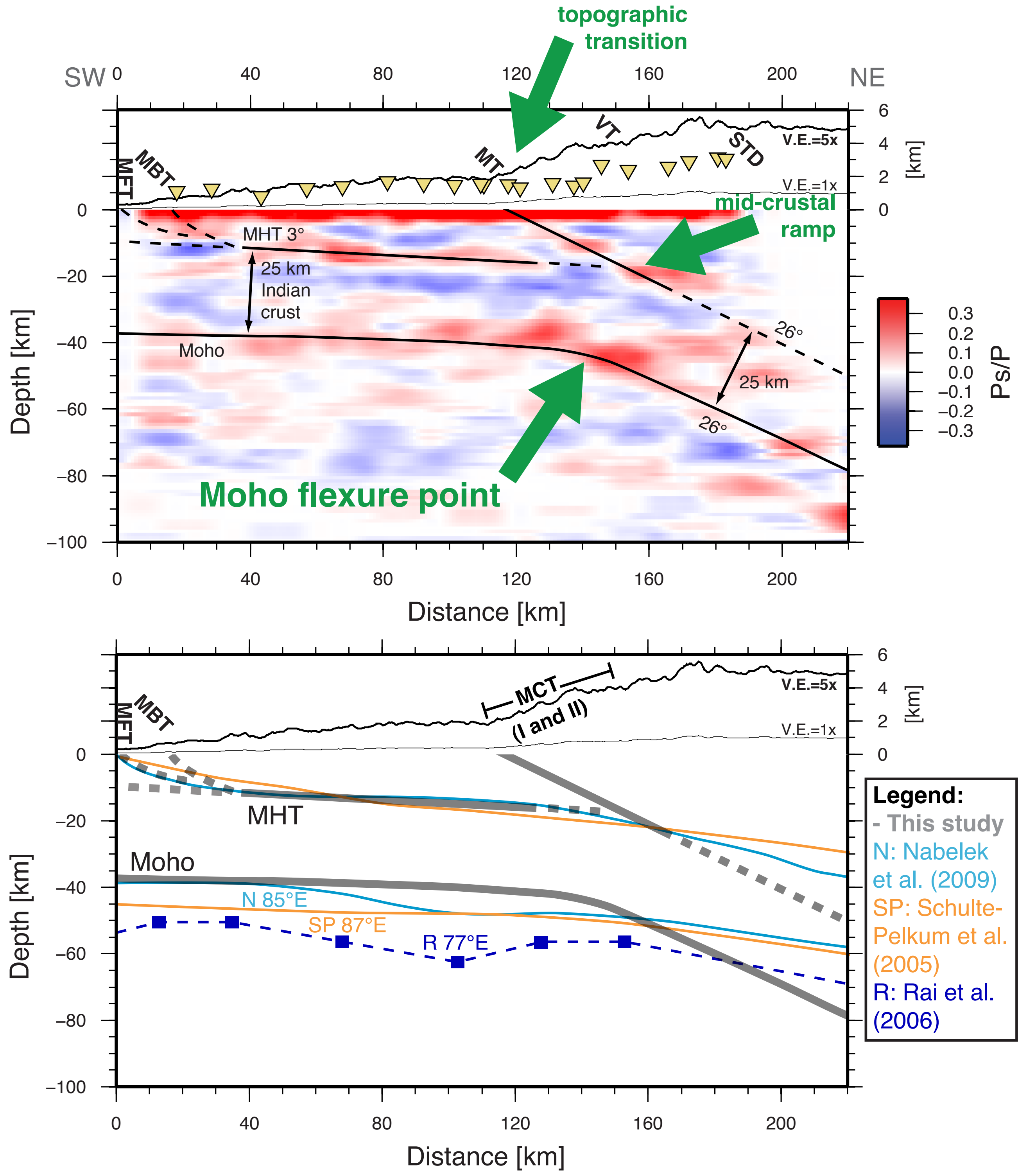


Ramps in the Main Himalayan Thrust (MHT) have been proposed on the basis of both stratigraphic reconstructions and geophysical observations. A mid-crustal ramp in the MHT may play a role in the formation of the steep topographic front of the Himalaya, by any of several currently-debated scenarios (1-3 above). The mid-crustal ramp is also likely a locking zone at which great earthquakes nucleate, so imaging the seismogenic zone has implications for understanding and characterizing earthquake hazard in the region.

4. RF Methods:

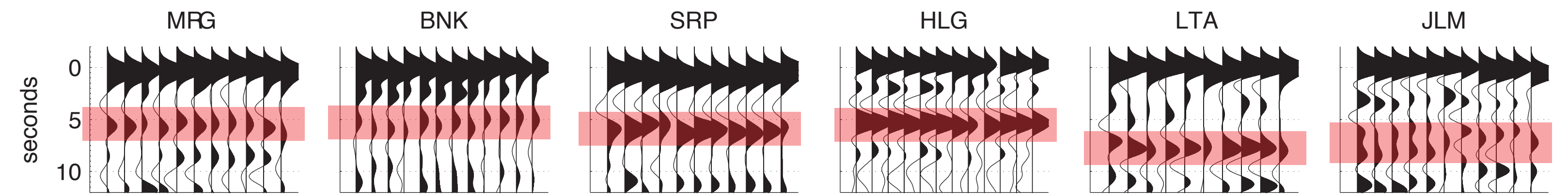
- We calculated 1000 receiver functions (RFs) using iterative time-domain deconvolution.
- Gaussian filter low-passes the RFs at ~1 Hz.
- RFs binned and stacked by common conversion point (CCP).
- Bin size 1km x 5km, smoothed over 15km horizontally.
- 30 bootstrap iterations of the stack yield a mean and standard deviation of each bin; bins with mean < 2std are masked to zero, meaning we have 95% confidence in the values shown.
- Velocity model for back-projection assembled from the literature.

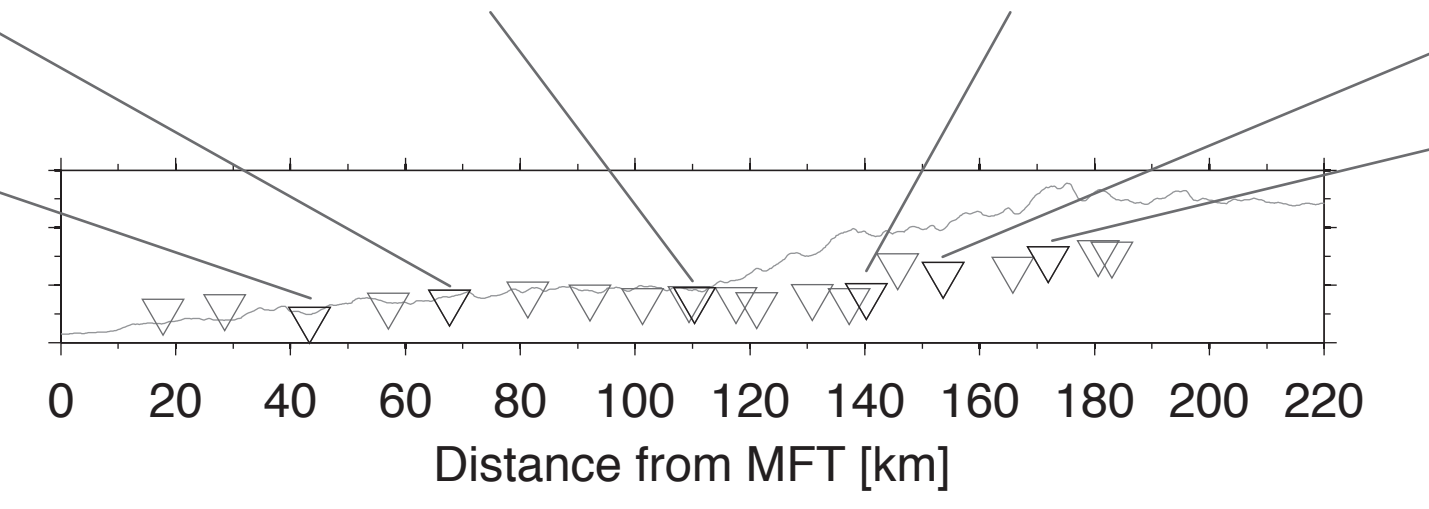
5. Receiver function CCP stack:



Top: 95% confidence smoothed CCP stack. Interpreted features are schematic guidelines representing a constant thickness of subducted Indian crust.
Bottom: Comparison of Moho and MHT depth from this study and other passive seismic imaging experiments (longtitude indicated).

5a. Selected 1-D receiver functions:

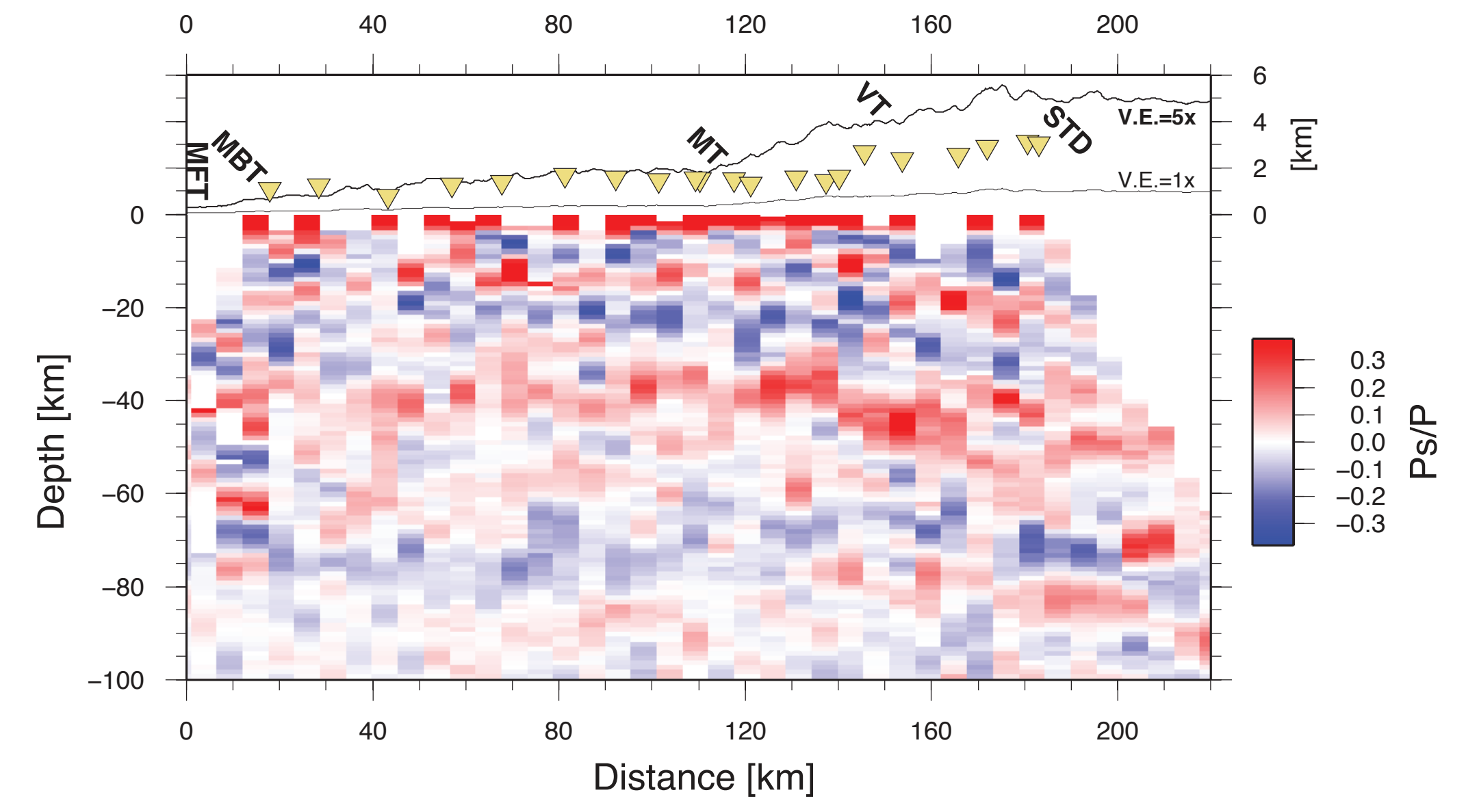




1-D unstacked RFs confirm the abrupt change in Moho depth beneath the High Himalaya.

6. 'Raw' CCP stack:

Minimally-processed CCP stack: no bootstrapping, masking, smoothing, or interpolation.



7. Conclusions:

1. In the Garhwal Himalaya, the Moho is flat beneath the Lesser Himalaya and steepens abruptly to a dip of ~25° beneath the High Himalaya.
2. This implies a sharp flexure of the Indian plate, requiring significant and abrupt lithospheric weakening.
3. The Moho flexure is located vertically beneath a mid-crustal ramp in the MHT, a feature which may control the topographic profile of the High Himalaya.
4. Although we cannot definitively test the three processes proposed to control uplift of the High Himalaya (passive overthrusting, duplexing, and out-of-sequence thrusting), our image of a strong impedance constrast across the Munsiari Thrust (MT, or MCT-I) may be suggestive of active, out-of-sequence thrusting.

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