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Geometry of the Main Himalayan Thrust in the Garhwal Himalaya from receiver function CCP stacking

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1. Location of our study:

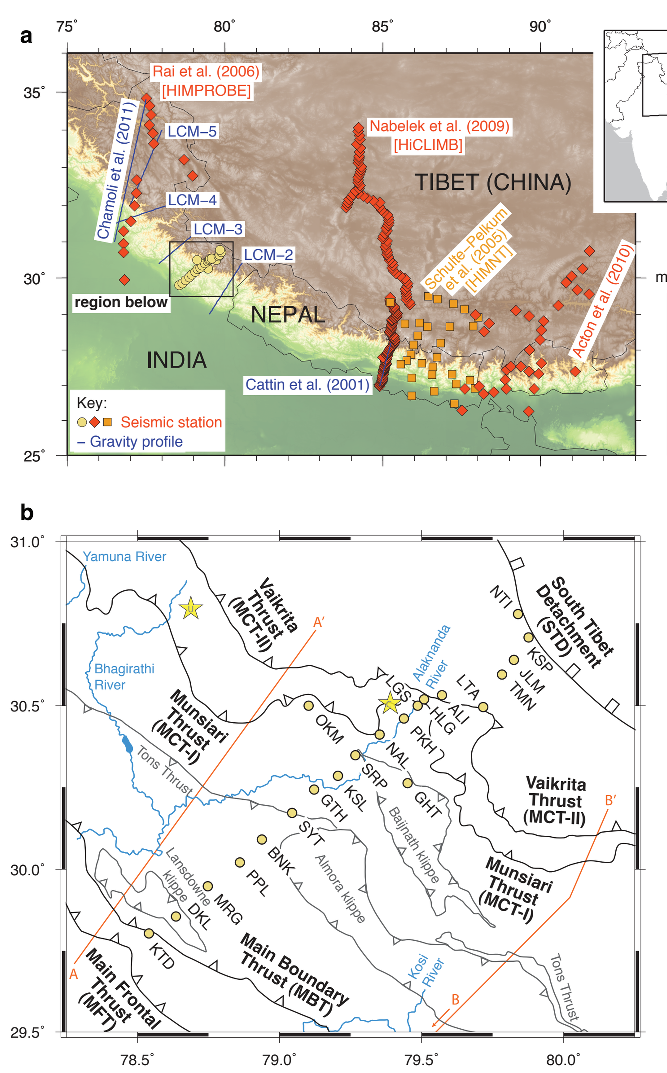


Figure 1: Location of our seismic array, and the locations of other major geophysical campaigns in the Himalaya.

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

2. Published structural cross-sections:

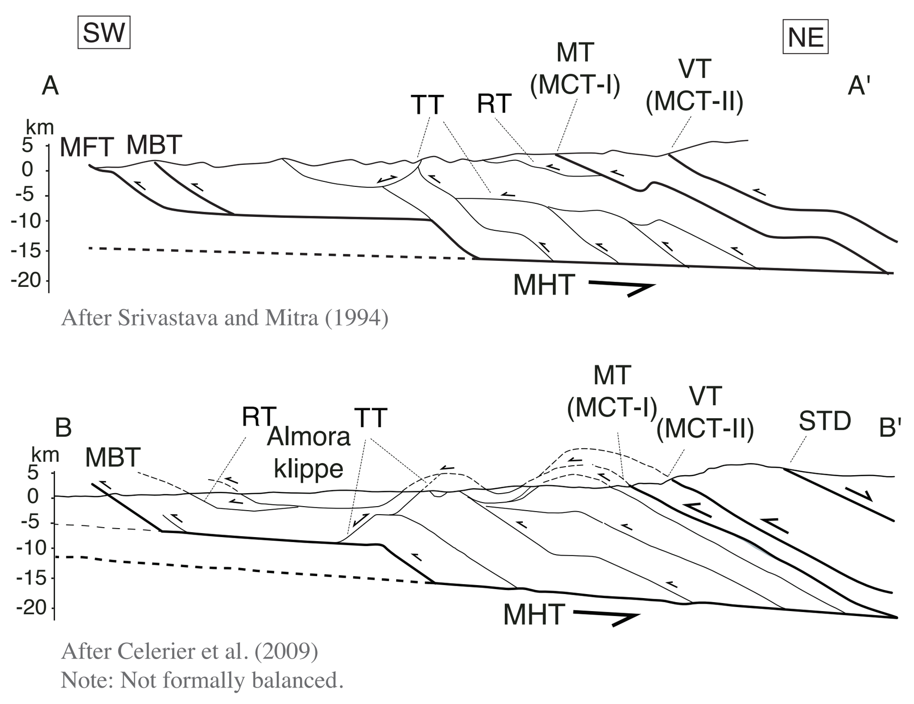


Figure 2: Published structural cross-sections through the Garhwal Himalaya.

Most Himalayan cross-sections show a ramp in the MHT inferred to be the nucleation area for catastrophic earthquake rupture on the MHT. We identify this ramp in our CCP image, and infer a position 20-30 km north of its previously-identified location in Garhwal.

Our geophysical imaging allows us to update these existing structural cross-sections.

3. Our receiver function CCP stack image:

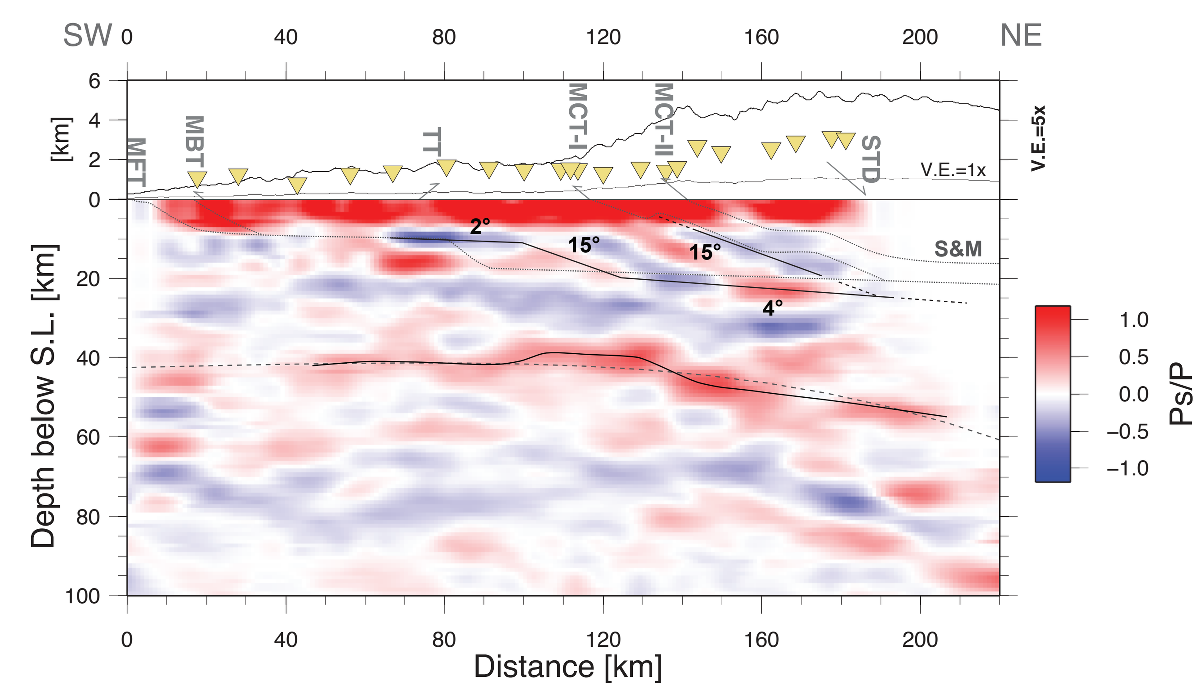


Figure 5: 95% confidence smoothed CCP stack. Our interpreted MHT shown in black. MHT from structural cross-sections shown dotted. *Our inferred ramp dips 15° and is located beneath the MCT-I (Munsiari Thrust).*

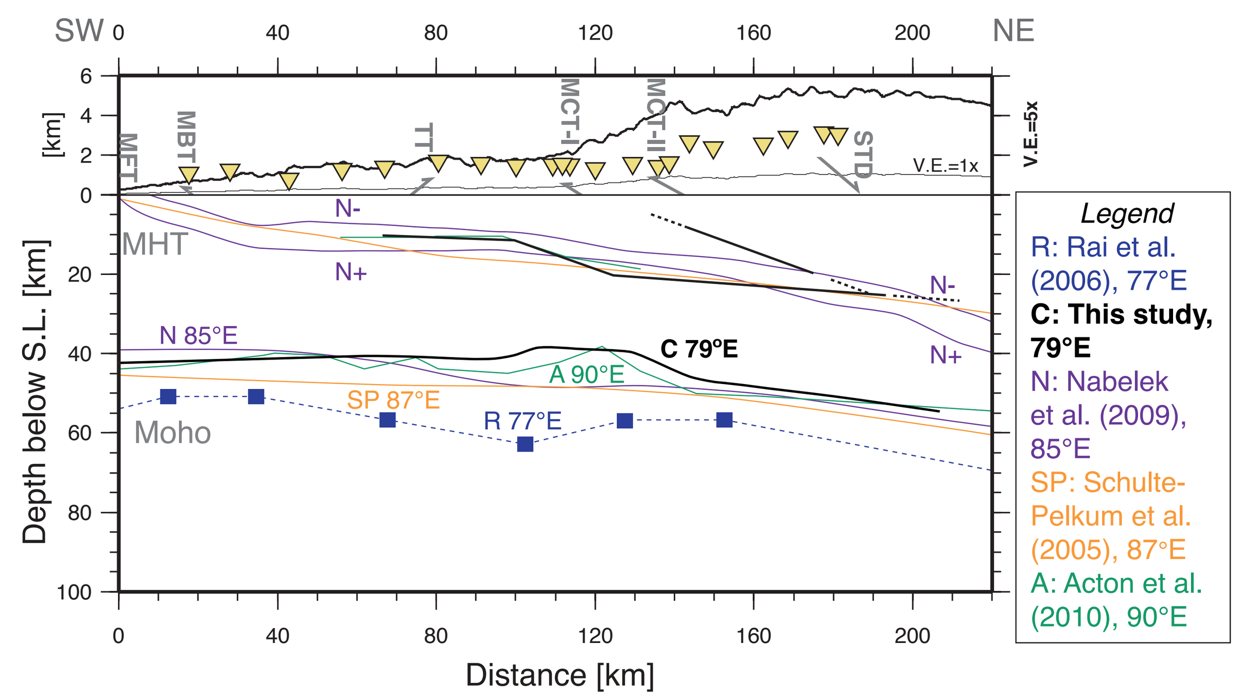
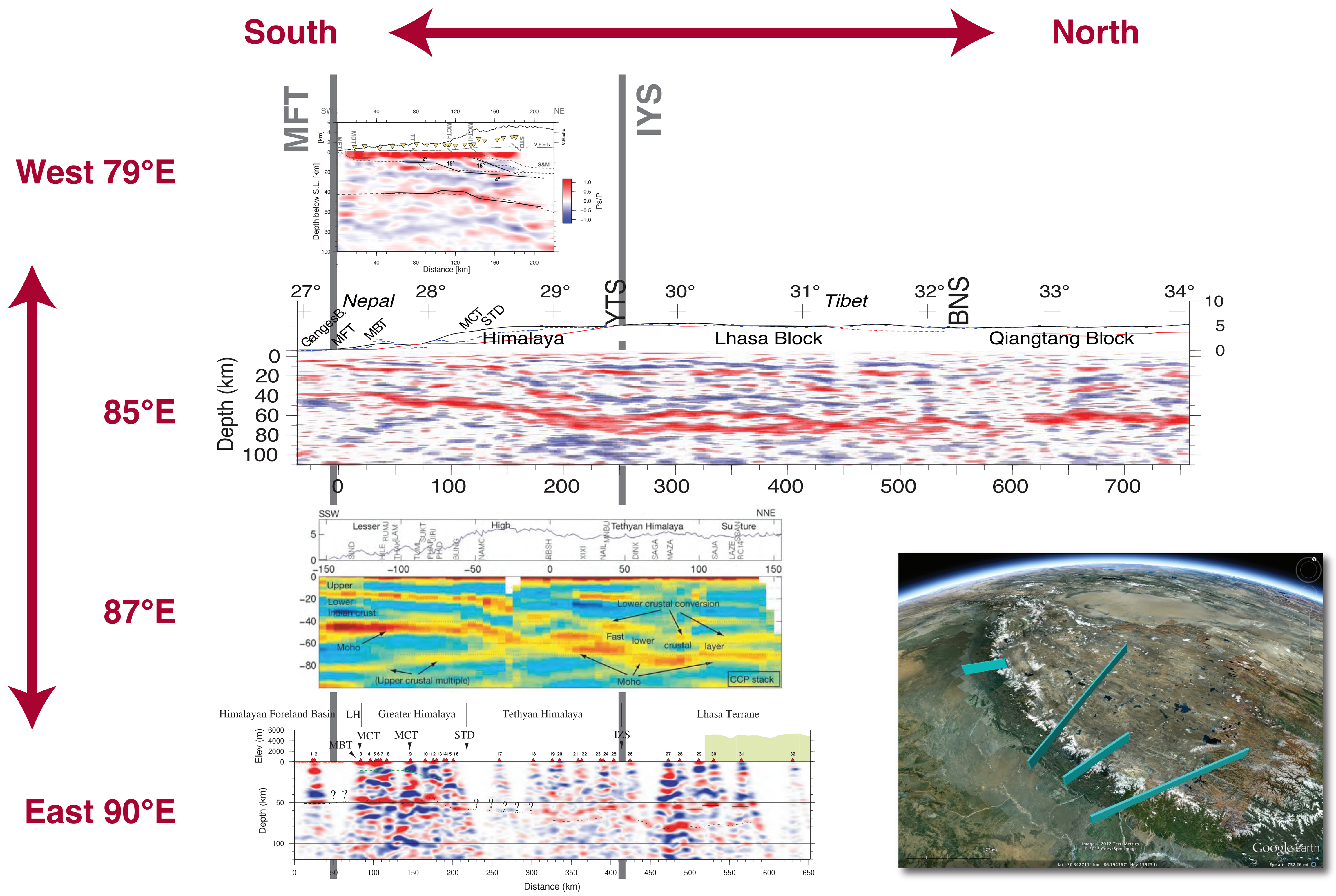


Figure 6: Comparison of Moho and MHT depth from this study and other passive seismic imaging experiments (longtitude indicated). (N- and N+ are alternate interpretations of the HiCLIMB profile.)

4. Compared to seismic investigations throughout the Himalaya:



5. Other recent geophysical work:

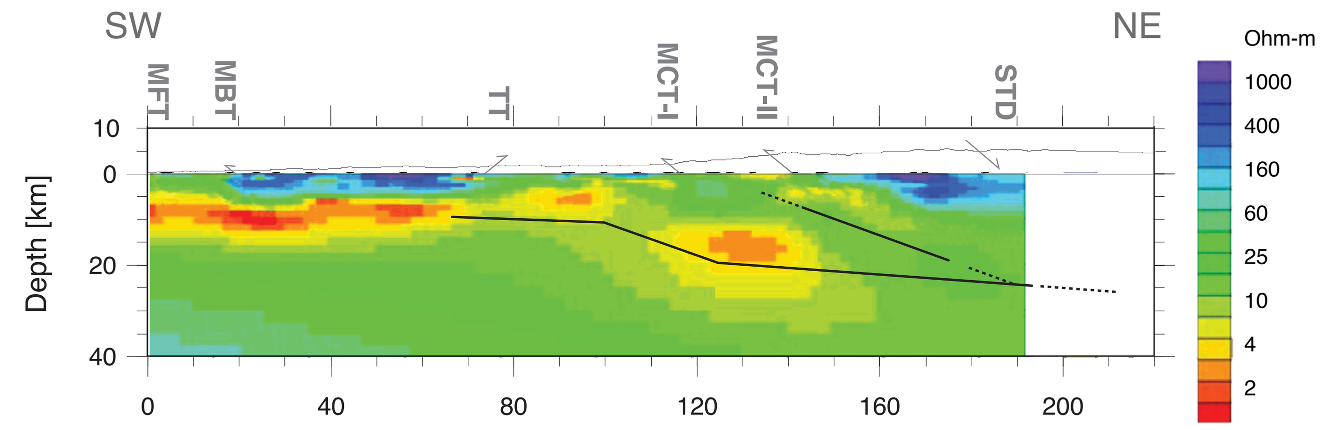


Figure 3: Low resistivities coincide with negative impedance contrasts in our CCP image, **observations best explained by fluids released in metamorphic reactions ponding at the detachment.**

Conductivity data from the forthcoming paper: Rawat, G., Arora, B. R., Electrical resistivity cross-section across the Garhwal Himalaya: Proxy to fluid-seismicity linkage, Geophysical Research Letters, in prep.

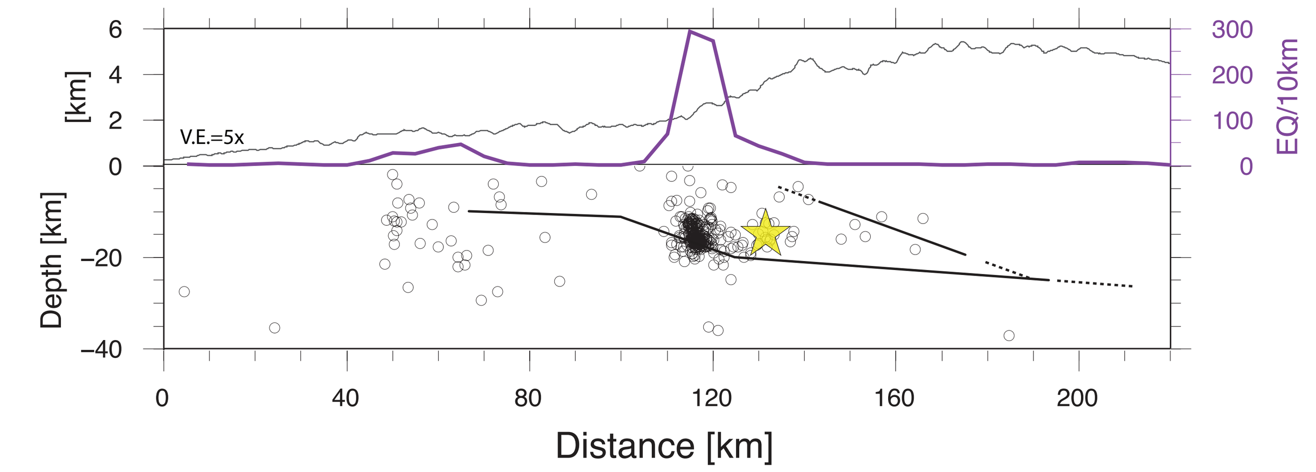


Figure 4: Local microseismicity is concentrated where we infer the base of a mid-crustal ramp, consistent with the ramp acting as a geometric asperity and possibly indicating the locking line of the MHT.

Seismicity data from Mahesh, P., Rai, S. S., Sivaram, K., Paul, A., Gupta, S., Sarma, R., Gaur, V. K., February 2013. One dimensional reference velocity model and precise locations of earthquake hypocenters in the Central (Kumaon-Garhwal) Himalaya. BSSA 103 (1).

6. Summary and Conclusions

1. We interpret the changing polarity of the MHT as caused by fluid accumulations at the MHT, and we re-locate the ramp on which great earthquakes may nucleate 20 km further north than previously mapped.

2. Passive seismic data are capable of addressing detailed thrust-fault geometry and providing input to structural cross-sections and earthquake-hazard estimations.

3. Cross-sections from west to east along the Himalaya must be compared using similar processing to better understand similarities and differences along-strike.

This work submitted to EPSL as 'Characterizing the Main Himalayan Thrust in the Garhwal Himalaya, India with receiver function CCP stacking,' by Caldwell et al.
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