3-D Shear Velocity Image of Crust and Uppermost Mantle Beneath the India-Eurasia Region and the Adjoining Indian Ocean from Ambient Noise and Earthquakes

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Abstract

The study aims at illuminating the evolutionary history of the India-Eurasian region and adjoining ocean from crust to uppermost mantle using a large number of available (global and local networks) seismological data set. We use shear velocity as proxy to map the lithospheric lithology to a depth of ~140 km. The shear velocity imaging is performed in two stages: (i) creation of Rayleigh wave group velocity maps from the time period of 10s to 70s and a horizontal resolution of 1^0x1^0, from ambient noise and earthquake waveforms recorded over seismographs; (ii) generating shear velocity depth images from reconstructed group velocities at node points and subsequently interpolating to have 2 and 3-D shear velocity images. We describe here significant features of geological domains from the region.

Study area and data

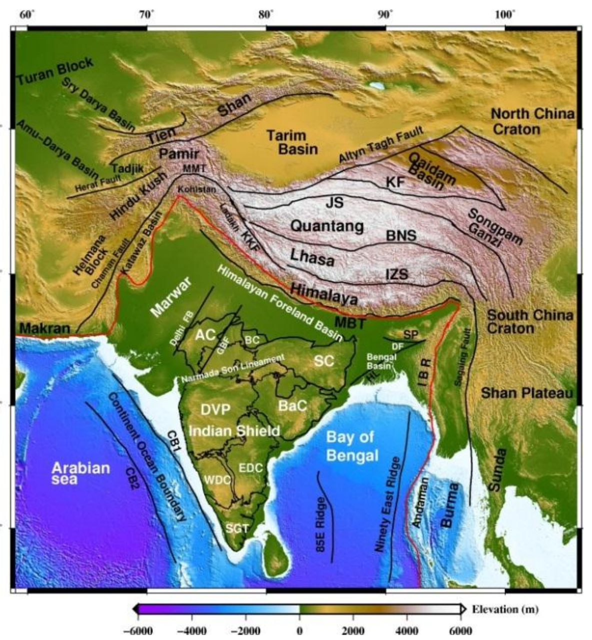

Fig. 1. Tectonic map of the study area.

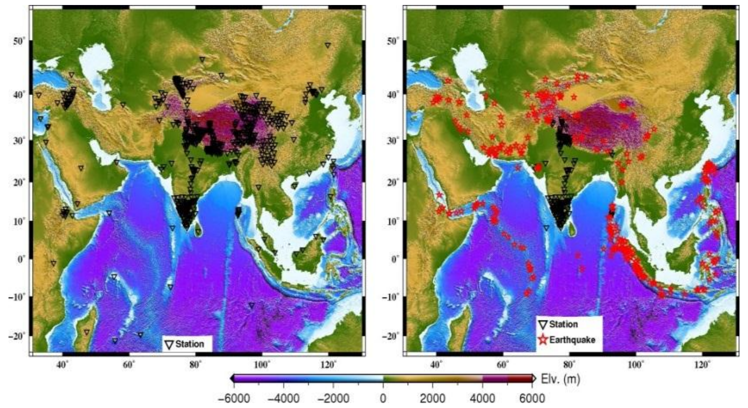

Fig. 2. Station and earthquake distribution.

- Seismic stations: 658.
- No. of earthquakes : 209.

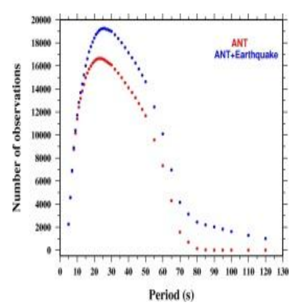

Fig. 3. Number of group velocity paths using (i) Noise data only (ANT). (ii) combining both Noise and Earthquake.

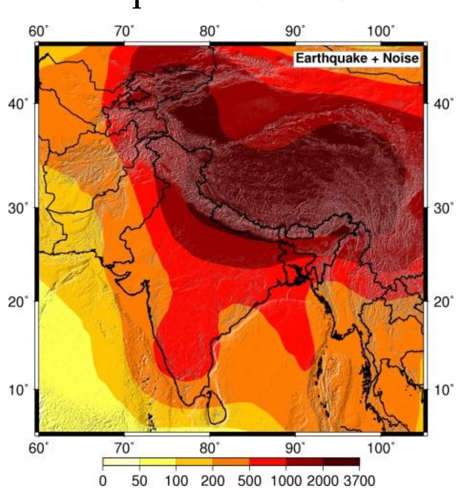

Fig. 4. Ray path coverage.

Results

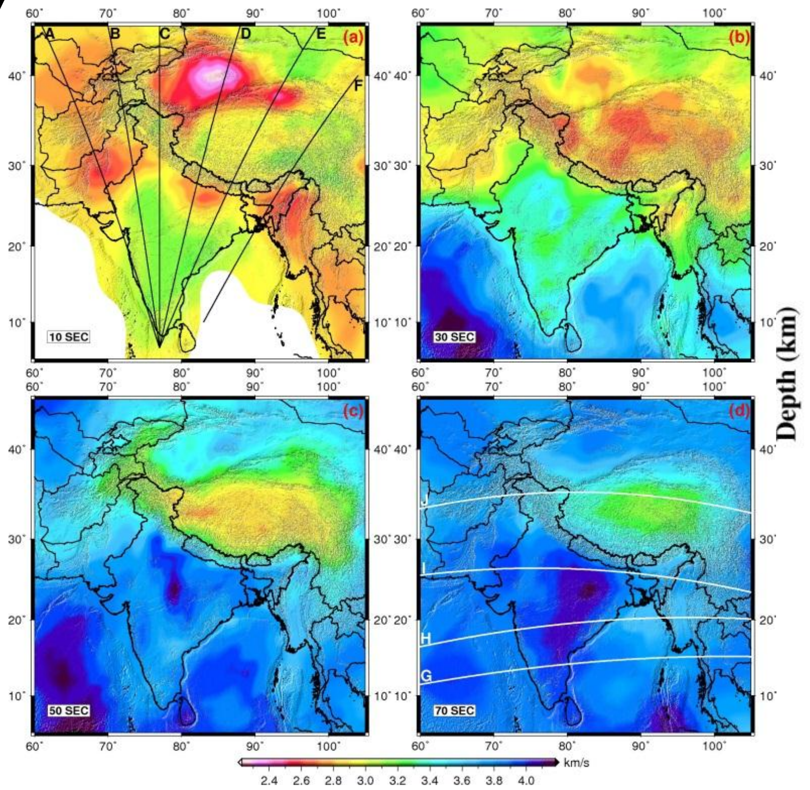

Fig. 5. Rayleigh wave group velocity Tomography maps for different periods (10s, 30s, 50s and 70s).

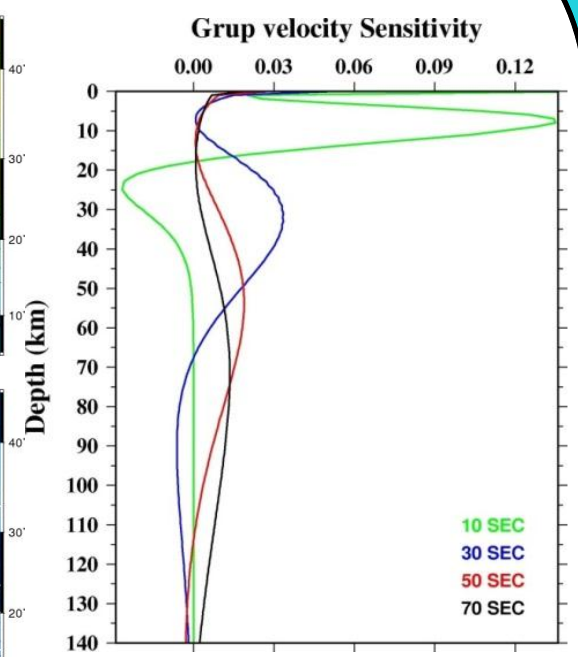

Fig. 6. Depth sensitivity of 10s, 30s, 50s and 70s.

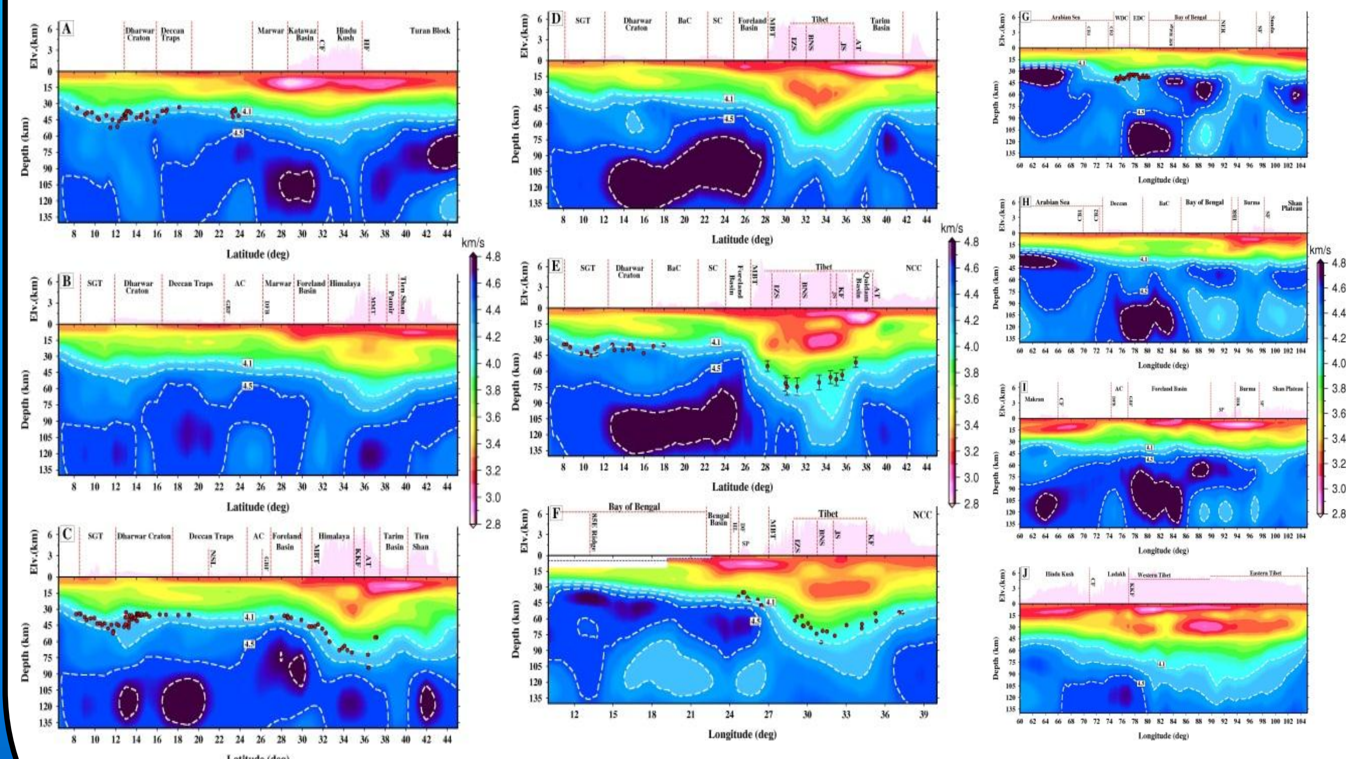

Fig. 7. Shear wave velocity – depth image along the vertical (A,B,C,D,E and F) and horizontal (G,H,I and J) profiles (shown in Fig 5(a) and 5(d)). Red circles denote Moho depths computed by previous study.

Significant Findings

- At short periods, Rayleigh wave group velocities correlate well with sediments, while at higher periods they are distinct in geological domains like the Indian Shield, Himalaya foreland basin and Tibet.
- The Moho imaged from the earlier studies (receiver function and refraction) correlate well with the depth at which shear velocity is ~ 4.1 to 4.2 km/s as derived from the present study.
- Significant velocity diversity in uppermost mantle in the Indian shield: presence of cold shield like structure (Vs>4.7 km/s).
- Evidence of significant low velocity (Vs ~2.9-3.4 km/s) in the mid crust at depth ~20-40 km beneath Tibet. This is conspicuously absent beneath the Ladakh and further west beneath Kohistan.
- No evidence for major offset in Moho depth from Ladakh to Western Tibet, pointing to Karakorum fault possibly not being a deep seated feature.
- Evidence for significant difference between Arabian sea and Bay of Bengal crustal structure. Continent–Ocean Boundary clearly mapped beneath the Arabian sea while it is highly disturbed beneath the Bay of Bengal.

Selected references

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Acknowledgments

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