Seismological evidence of mafic underplating beneath Central India

Kuntal Chaudhuri*, Kajaljyoti Borah, Ayush Goyal
*kuntal11012@gmail.com
Indian Institute of Science Education and Research Kolkata

Abstract

Crustal shear velocity structure across the Narmada Son Lineament (NSL), a major tectonic feature through Central India, & the adjoining regions have been investigated by the joint inversion & neighborhood algorithm of receiver function at 17 locations in the study region. The results show significant variations of crustal thickness & average crust shear wave velocity (avg. V_s) in the region, viz. 38-42 km thick crust with avg.V_s~3.7 kms^{-1} under Deccan Volcanic Province (DVP); 38-42 km thick crust with lower avg.V_s~3.5 kms^{-1} in the Vindyan Basin; 44 km thick crust with avg. Vs~3.7 kms^{-1} beneath Bundelkhand craton. Thicker crust (~56 km) with avg.V_s~3.8 kms^{-1} is observed beneath Narmada South Fault (NSF), north of DVP. Presence of High velocity layer(V_s>4.1 kms^{-1}) at lower crust beneath most part of the study region suggest the existence of a mafic underplated layer at the base of the crust.

Objectives

- To check whether the crustal evolution model complies with the given models.
- Is the nature of the crust causing the earthquakes?
- To find out the crustal properties of the unknown lower crust in the study area.
- Try to resolve the debate regarding the thickness of the crust under the NSL.

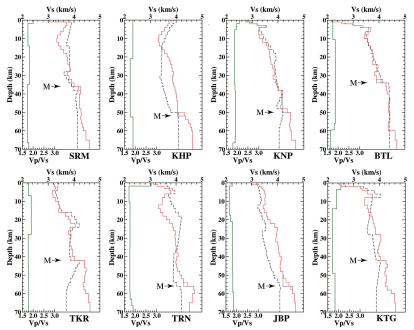
Methodologies

The Techniques used in this study are:

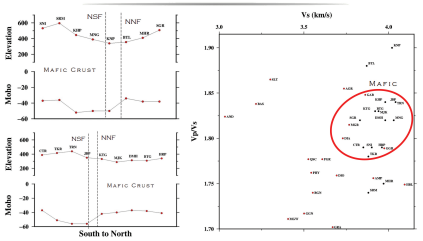
- Receiver Function Analysis from earthquake events.
- Inversion using Neighborhood Algorithm (NA) for global optimization.
- Joint Inversion using Surface Wave Dispersion data.
- Forward Modelling for simplified model.
- Compositional Analysis using NA model.

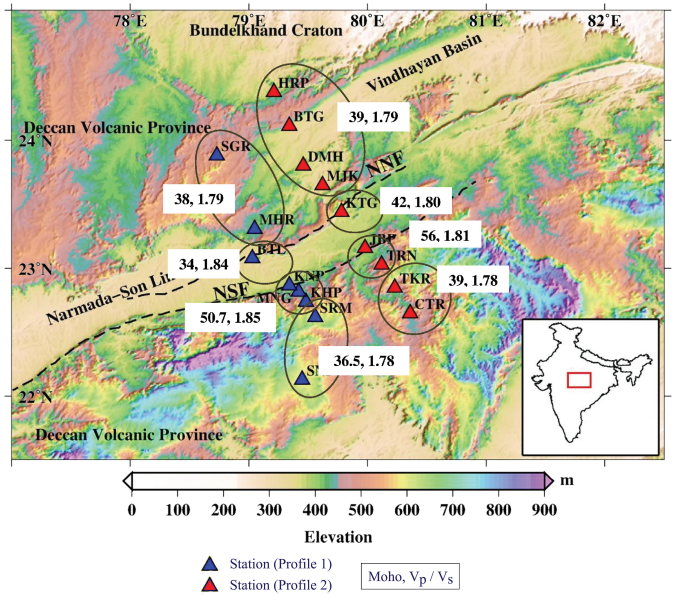
Results

Velocity Models

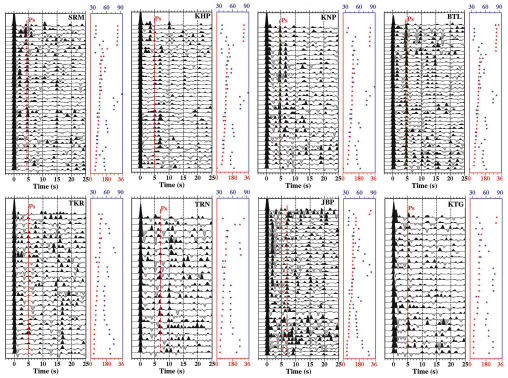


Cartoon & Composition Plots

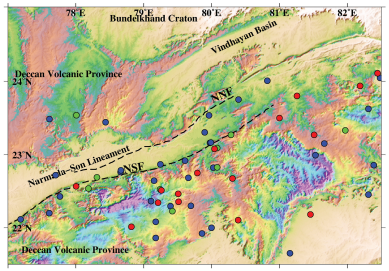




Receiver Function Plots



Earthquakes



- Upper Crust (< 15 km)
- Middle Crust (> 15 km and < 30 km)
- Lower Crust (> 30 km)

Discussions

- Thickness of the crust complies with the models given by Durrheim and Mooney, 1991 predicting a higher thickness of the proterozoic crust.
- The average composition of the lower crust predicts the presence of mafic intrusion in the layer.
- The upper, middle and the lower crusts are highly seismogenic and presence of any fluid layers could not be identified
- The higher thickness of the crust beneath the NSF predicts the presence of intense plume activity that can be attributed to the presence of mafic under plated layers that promoted the rifting in the area.

References

Choubey, V. D, 1971, Narmada–Son Lineament, India: Nature, v. 232.28, p. 38-40.
Crookshank, Henry. Geology of the northern slopes of the Satpuras between the Morand and the Sher rivers. Central Book Departmentôt in Komm., 1936.
West, W.D., 1962, The Line of Narmada valley: Curent Science, v.31.4.
Ghosh, D.B., 1976, The nature of Narmada-Son Lineament: In seminar volume on Tectonics and Metallurgy of South and East Asia, v.34.

Acknowledgments

We acknowledge National Geophysical Research Institute (NGRI) for providing us the data. We are greatful to Prof. Robert B. Herrmann and Prof. Charles J. Ammon, and Prof. M. Sambridge for providing their Computer Program in Seismology and NA Programs. This work is supported by Startup Grant from IISER K to Dr. Kajaljyoti Borah.