Crustal melts in the NW Himalaya observed by surface-wave dispersion

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We calculated one-dimensional velocity profiles by analyzing dispersion of surface waves from regional earthquakes (Caldwell *et al.*, 2009). Our data came from an array of 16 broadband seismometers operated by India's National Geophysical Research Institute and Cambridge University. The array spanned the western Himalaya between the Indian plain and the Karakoram Range (Figure 1).

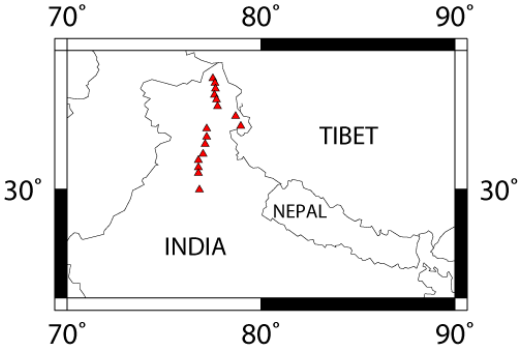

Figure 1. Location of array used for this study. The array spanned ~600 km and was composed of 16 stations.

We calculated the group velocity dispersion of fundamental-mode Rayleigh waves, and then inverted the dispersion records to obtain one-dimensional shear-wave velocity profiles (Figure 2). Our velocity models show a low-velocity layer (LVL) with 7-17% velocity reduction centered at ~30 km depth and apparently continuous from the Tethyan Himalaya to the Tibetan plateau. This LVL shows good spatial correspondence with the observations of low resistivity from magnetotelluric (MT) studies along the same profile (Arora *et al.*, 2007). Of the possible explanations for low velocity and low resistivity in the mid-crust, only the presence of melts or aqueous fluids (or both) satisfactorily explains both sets of observations. Observations of elevated heat flow in the northwest Himalaya (Thussu, 2002) imply that if aqueous fluids are present in the mid-crust, then the mid-crust is above its solidus. Comparison of our results with laboratory measurements and theoretical models suggests 3-7% melt is present in a continuous layer in the upper-middle crust of the northwest Himalaya at the present day, and thus the physical conditions necessary for active channel flow seem to be present.

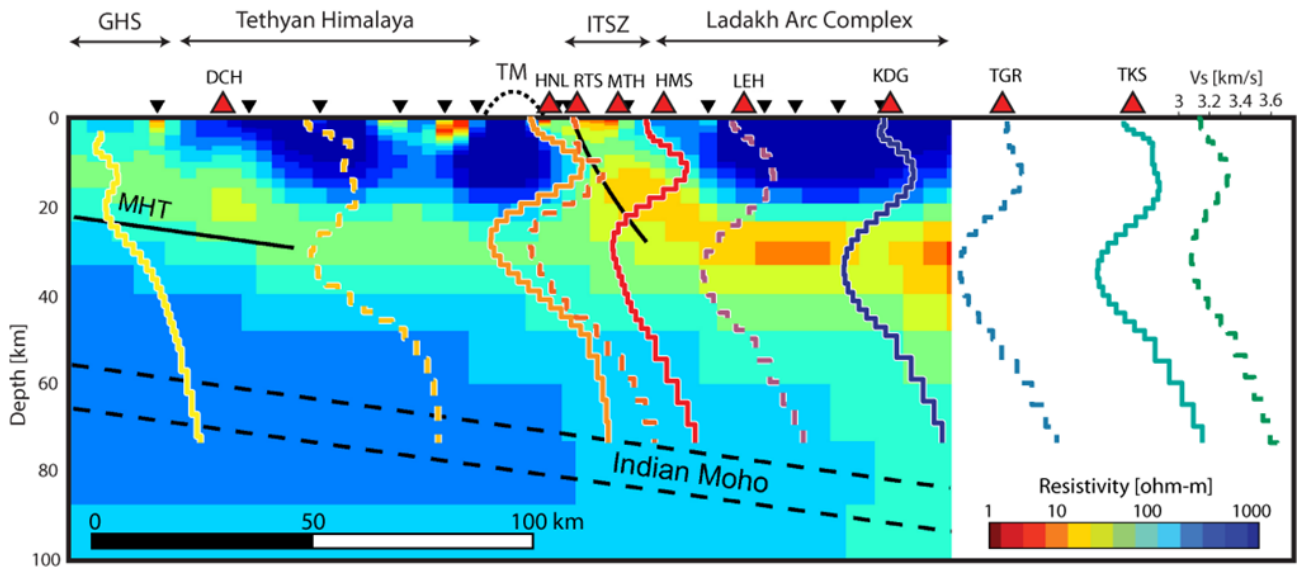

Figure 2. Velocity profiles projected to their approximate locations in a N-S profile across the Himalaya. Background image is the MT profile of Arora et al. (2007). The low-velocity layer (LVL) in our models shows good spatial correspondence with the low-resistivity layer inferred from the MT data. Downward-pointing triangles: MT stations of Arora et al. (2007). Upward-pointing triangles: our seismic stations.

References

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