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Seismic investigation of upper mantle discontinuities under the Indian-Asian collision zone with PP precursors

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In this study we investigate the upper mantle discontinuities in the Himalayan-Tibetan collision zone. We use PP precursors which are reflections of P waves at the discontinuities halfway between the source and the receivers. We use different source-receiver combinations with distances from 80 to 120 degrees. Earthquakes in the Northwest to West Pacific with magnitudes from 5.9 to 6.7 were recorded at temporary and permanent networks in Ethiopia (EAGLE, PennState Array), in Israel and Jordan (DESERT, DESIRE and Israel Broadband Seismic Network) and in Germany (Gräfenberg array and GRSN), yielding reflections points from Northern India across Tibet to Northern China. Methods from array seismology e.g. vespagrams and frequency wavenumber analysis are used to measure the slowness and the backazimuth of the PP phase and its precursors with improved vertical and lateral resolution.

The precursors are analyzed in terms of frequency content, polarity, amplitude, waveform and arrival time. The frequency content is related to the sharpness of discontinuities and thus helps to determine the depth interval of the phase transitions. The polarity and the amplitude depend on the impedance contrast at the discontinuities. Migration transfers differential traveltimes of PP precursors relative to the reference phase into depth images of reflections in the upper mantle. The results will be compared with synthetic seismograms using full waveform modeling to corroborate the interpretation.

Beside the 410 and the 660 km discontinuity, we investigate the existence and properties of other discontinuities e.g. at 520 km or at 600 km depth (phase transition of garnet to ilmenite). Our aim is a high resolution image of the upper mantle to investigate the fine scale structure of the discontinuities. The fine scale structure mirrors lateral thermal and compositional variations and gives constraints on the influence of minor mantle minerals on the major phase transitions between 410 and 660 km depth.