

# **Delamination of mantle lithosphere from underthrusting crust during continental collision in eastern Himalaya and Tibet**

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When continental collision succeeds oceanic subduction, the mass balance of the orogenic belt is to first order controlled by the behavior of the underthrusting continent, for example India that dives beneath Tibet at the Himalayan frontal thrust. Whether underthrusting continent (India) directly underplates the overriding continental crust, displacing the asthenospheric mantle wedge formed beneath Tibet during oceanic subduction, or whether all or part of the underthrusting lithosphere subducts beneath the mantle wedge, has long been controversial. Here we show S-wave receiver-function (SRF) images of the Indian lithosphere-asthenosphere boundary (LAB) at ~200 km depth beneath the Himalaya, offset from a Tibetan LAB at ~120 km depth that is only present north of the mantle suture as independently defined from helium isotopic data. We employed 4,051 S-to-P receiver functions (SRFs) obtained from 462 stations (mainly two E-W seismic arrays) to delineate this lithospheric geometry beneath the Indian-Asian collision zone from 86°-100°E. From 92–96°E the Tibetan LAB can be traced southwards beneath the entire Lhasa terrane to south of the surface suture zone (the Yarlung-Zangbo suture, YZS, northern limit of Indian continental rocks), implying that the Indian mantle lithosphere must be delaminating from the Indian crust. This delamination process is likely the trigger for gravitational instability, hence subduction, of continental lithosphere deep into the upper mantle.