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A receiver function study of the southern Costa Rican subduction zone

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The Central American subduction zone is particularly interesting due to its pronounced lateral variability. To explore the deeper structure of the subduction zone, a transect of broadband seismometers across the Talamanca Range (Southern Costa Rica) was operated from spring 2005 to spring 2007. This region is characterized by the subduction of the aseismic Cocos Ridge, which has been observed to dip at an angle of 18 deg down to depths of about 40 km. Based on this shallow angle, it was speculated that shallow underplating of the Cocos Ridge is responsible for the gap in active volcanism and strong uplift in this region.

We performed a standard receiver function analysis of 522 teleseismic earthquakes, yielding 1777 receiver functions. The Moho of the overriding plate is imaged around 35 km depth, and an intracrustal discontinuity is observed at about 20 km depth, in good comparison with previous active seismic studies. Below 40-50 km depth, however, the receiver functions show a steeply dipping plane (60 deg), interpreted as the subducting Cocos Plate, which reaches a depth of about 170 km. These results show for the first time that the Cocos Ridge is subducting beneath southern Costa Rica at a considerably larger angle and to greater depths than previously thought, opening new questions about the mechanism causing the gap in active volcanism and strong uplift in the Cordillera de Talamanca.