# Structure, dynamics, origin, and evolution of the Peruvian flat slab: Results from PULSE

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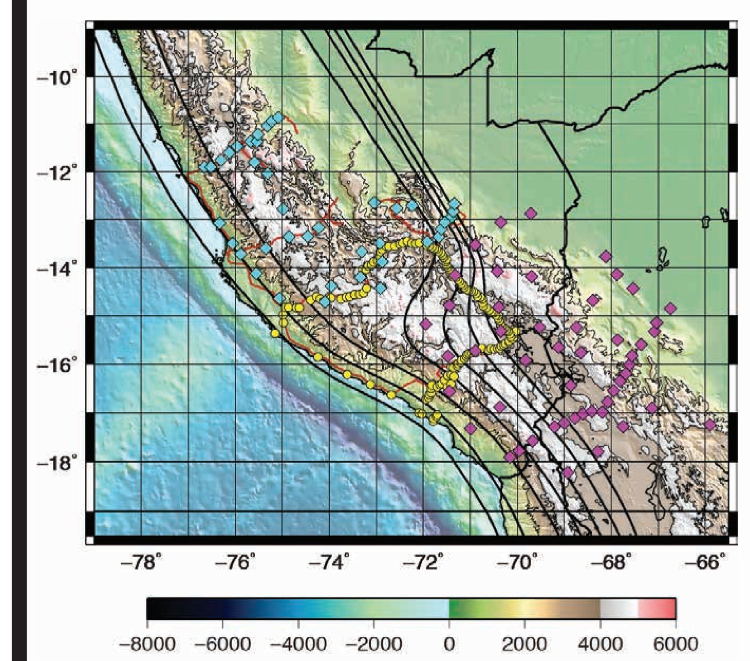
## The PULSE Experiment

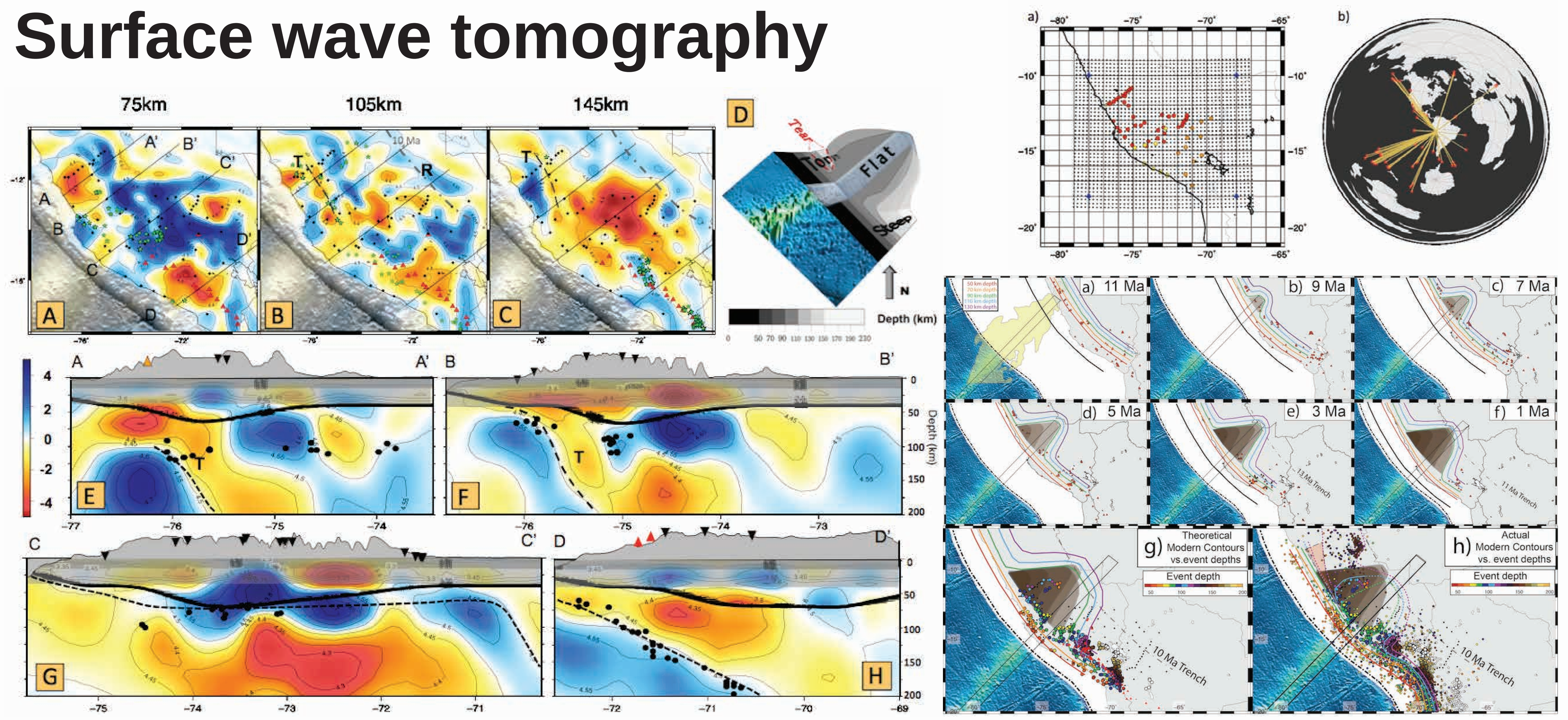


The Peru Lithosphere and Slab Experiment (PULSE) was a deployment of 40 broadband seismometers (blue) from 2011-2013 above the southern portion of the Peru flat slab segment. Contemporaneous with two other experiments in Peru: PeruSE (yellow) and CAUGHT (pink).

Major science questions addressed: 1) How do flat slabs form? and 2) What is the effect of flat slab subduction on the overlying lithosphere?

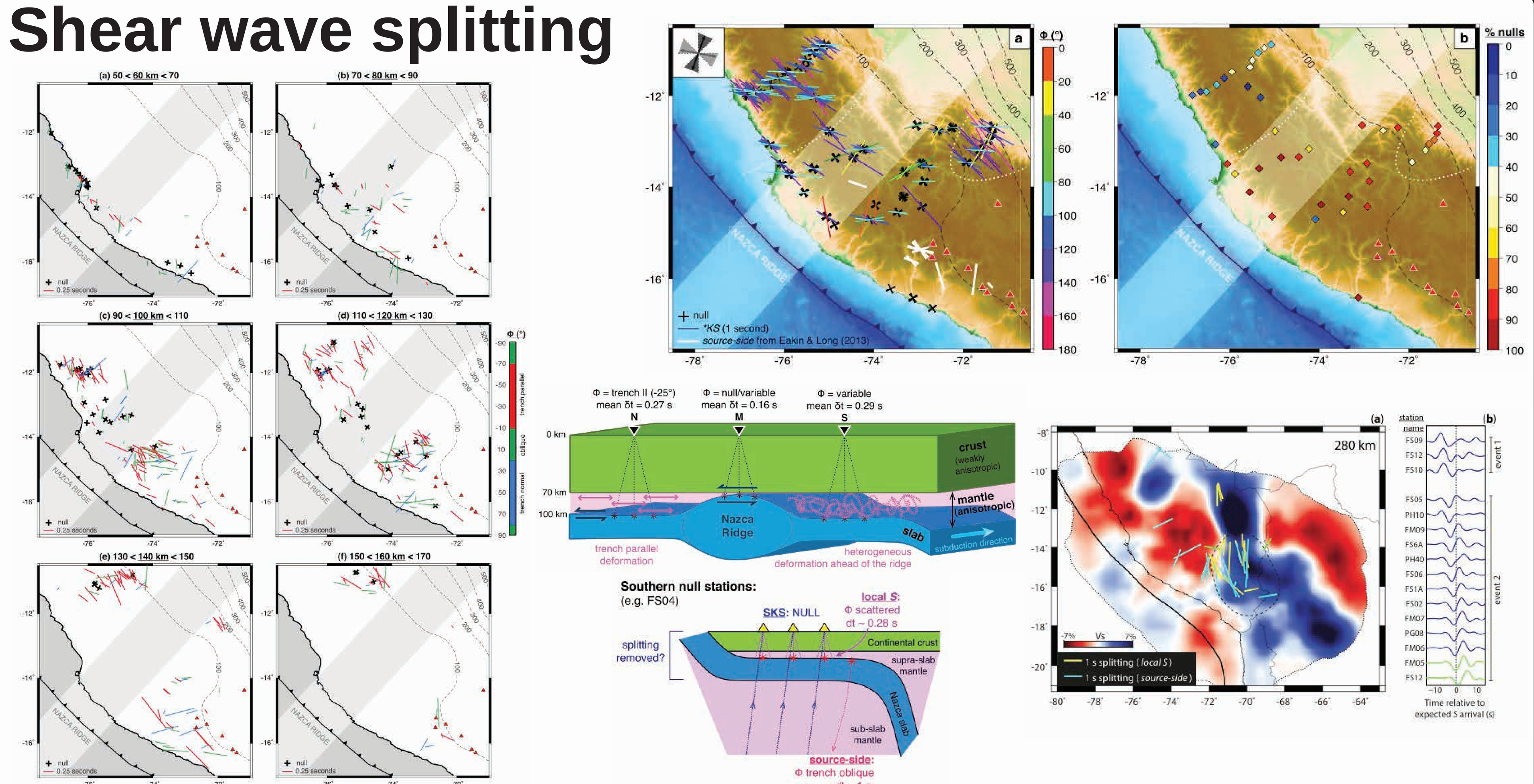
Analysis of PULSE data is ongoing and includes body and surface wave tomography, receiver function analysis, shear wave splitting analysis, and earthquake hypocenter and focal analysis determinations. **Key findings:** 1) The Nazca Ridge appears to play a major role in controlling the slab morphology and the deformation of the surrounding mantle. 2) We image an inferred slab tear near Lima that may correspond to re-subduction of the plate. 3) The shallowest part of the slab is directly beneath the Nazca Ridge.

## Surface wave tomography



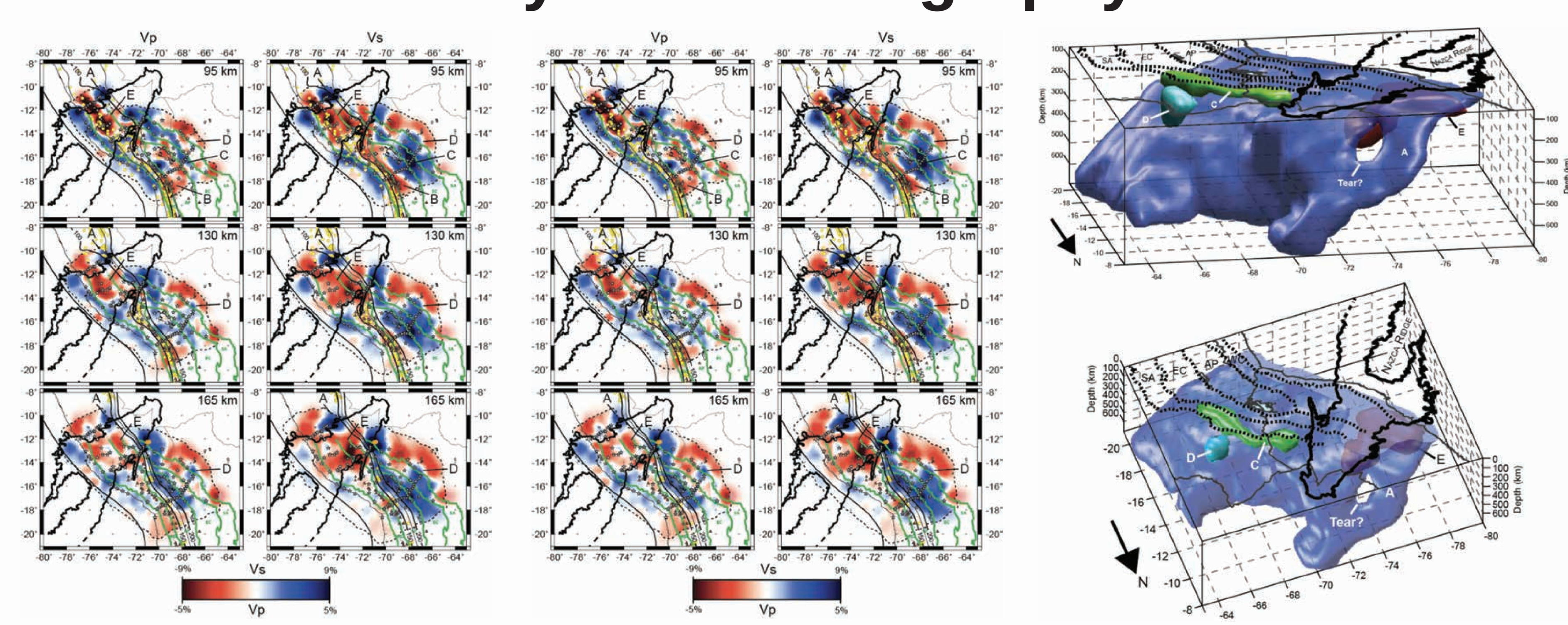
Left: three-dimensional model of shear-wave velocity structure derived from event-based surface waves, shown as depth slices (top panels) and cross-sections (middle and bottom panels). Panel D shows the inferred slab geometry along the Nazca Ridge track, and the inferred slab tear north of the ridge. Top right: stations and events used in the inversion. Bottom left: Proposed temporal evolution of the Peruvian flat slab. From Knezevic Antonijevic et al., Nature (2015).

## Shear wave splitting



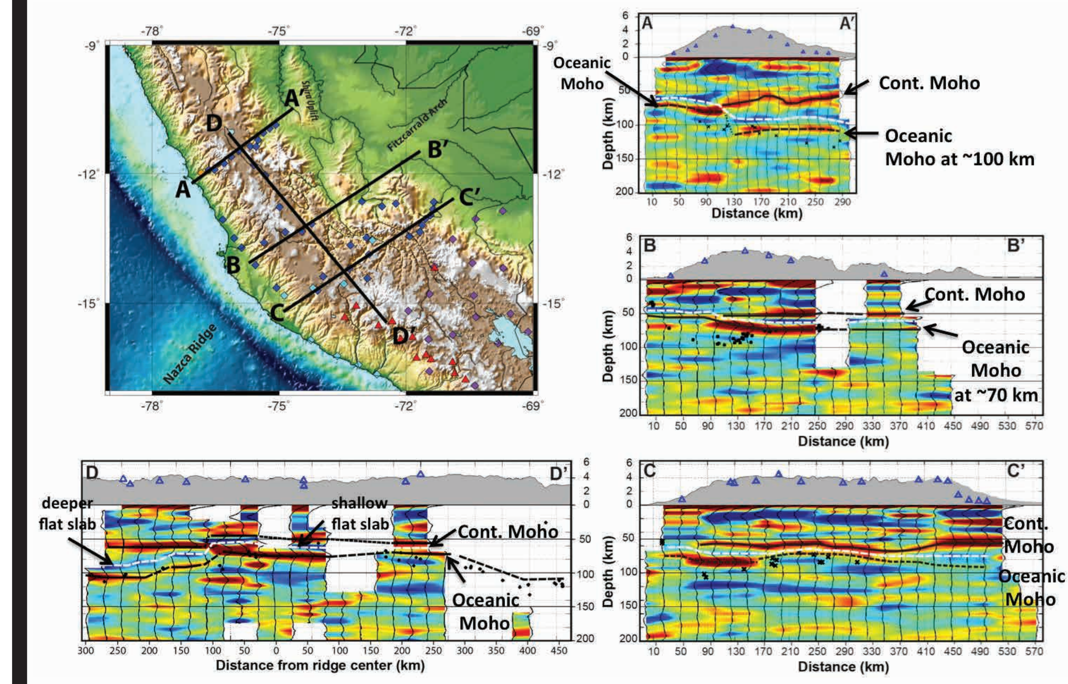
Measurements of local S splitting (left, plotted for a series of event depths) show a striking change across the Nazca Ridge (see cartoon in center). SKS splitting (top right) displays similar behavior, with much larger delay times. We also observe splitting due to anisotropy within the slab (bottom right), indicating intraslab deformation in the upper mantle. From Eakin et al., GRL (2014), Eakin et al., EPSL (2015), and Eakin et al., Nat. Geosci. (accepted).

## Teleseismic body wave tomography



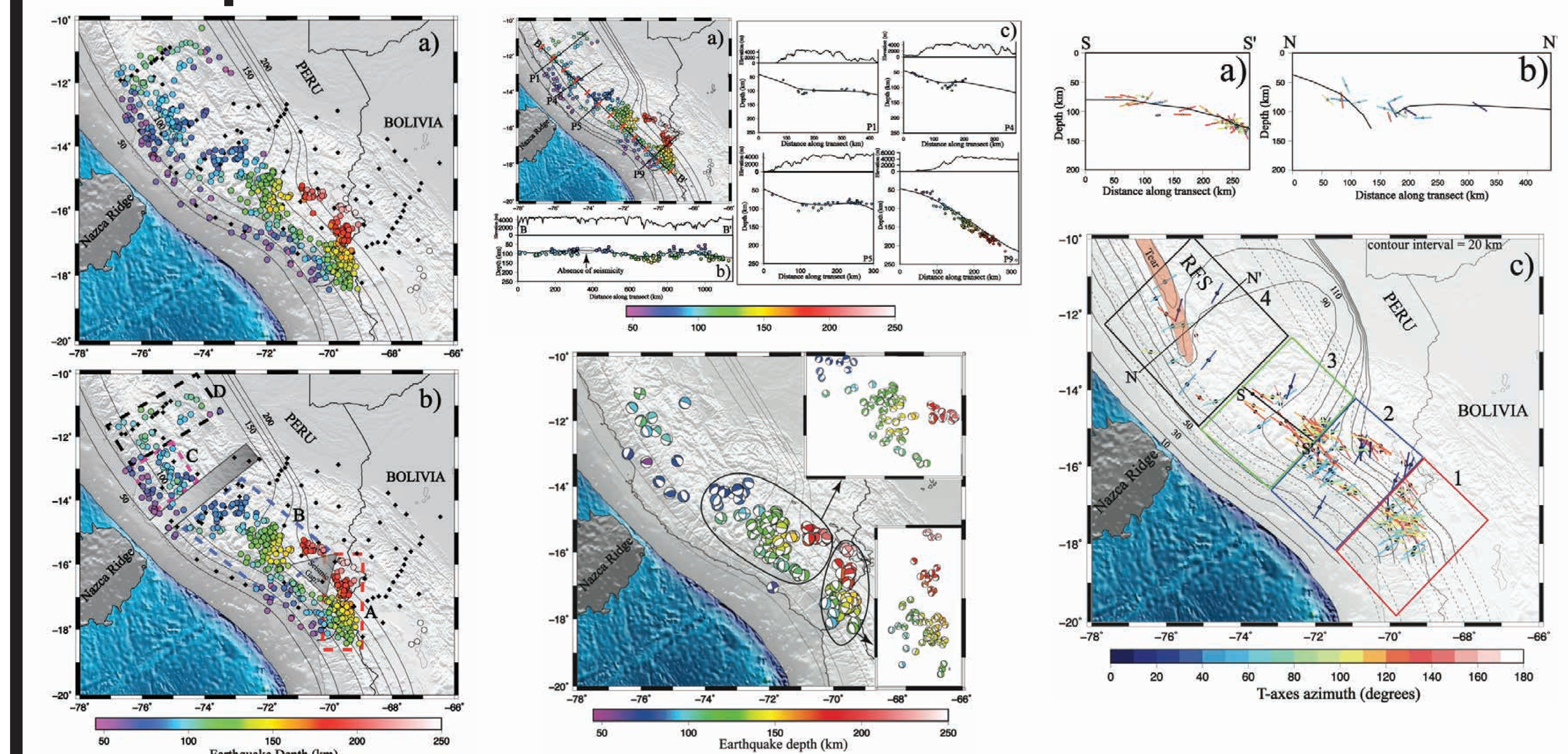
Left and middle panels: Horizontal depth slices for the Vp (left) and Vs (right) tomographic models. Dashed lines represent the edges of the well-resolved region of the model. Heavy black line marks the projection of the subducted Nazca ridge. Right panels: 3-D diagram of the resolved subducting Nazca slab and prominent low-velocity anomalies. Isosurfaces represent contours of -3% and +3% relative velocity perturbations. From Scire et al., GJI (in review).

## Receiver function analysis



Common conversion point (CCP) stacks of P-to-S receiver functions clearly show the continental Moho as well as the Moho of the down-going slab. The flat slab is shallowest beneath the Nazca Ridge (see along-strike D-D' cross section), with little, if any, remnant mantle wedge material between the top of the flat slab and the bottom of the overlying crust. From Bishop et al. (in preparation).

## Earthquake location and focal mechanisms



Left: Earthquake hypocenters calculated using single event (top) and relative (bottom) location methods. Center, top: Cross sections through event distributions. Center, bottom: Focal mechanism solutions. Right: Map and cross sections of T axes. From Kumar et al., EPSL (in revision).

## References and acknowledgements

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