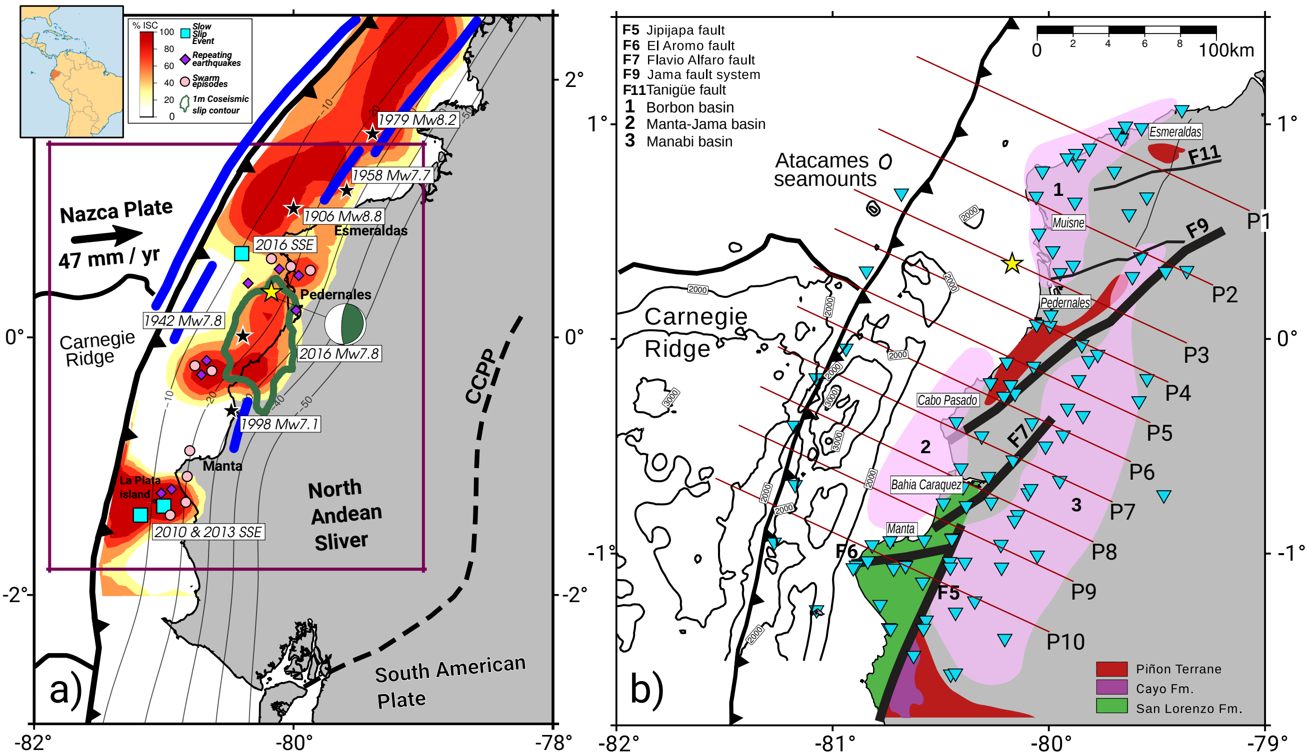

Figure 1: **Seismotectonic and geological setting. a)** Seismotectonic setting of the study area. Solid blue lines represent the extension of historical earthquakes in the area. Epicentres of those events are indicated with a black star. Slow slip events, repeating earthquakes and seismic swarm episodes are also represented by squares, diamonds and circles, respectively. 2016 Pedernales earthquake is shown including its epicentre (yellow star), cosesimic slip by Nocquet et al., 2017 (solid green line) and focal mechanism (green beach ball). Distribution of the interseismic coupling by Nocquet et al. (2014). Chingual-Cosanga-Pallatanga-Puna fault (CCPP) that created the North Andean Sliver (NAS) is represented by a segmented line. **b)** Geological context and recording network. Main formations, sedimentary basins and faults mapped by Reyes and Michaud (2012) are displayed by coloring forms and solid black lines. Offshore, residual bathymetry derived by Agurto-Detzel et al. (2019) is shown in solid black line. Permanent Ecuadorian network (RENSIG, Alvarado et al., 2018) and emergency deployment (Meltzer et al., 2019) are shown in gray inverted triangles. Profiles, P1-P10, discussed in this work are plotted in solid red line. Yellow star represents the epicentre of the 2016 Pedernales earthquake (Nocquet et al., 2017).

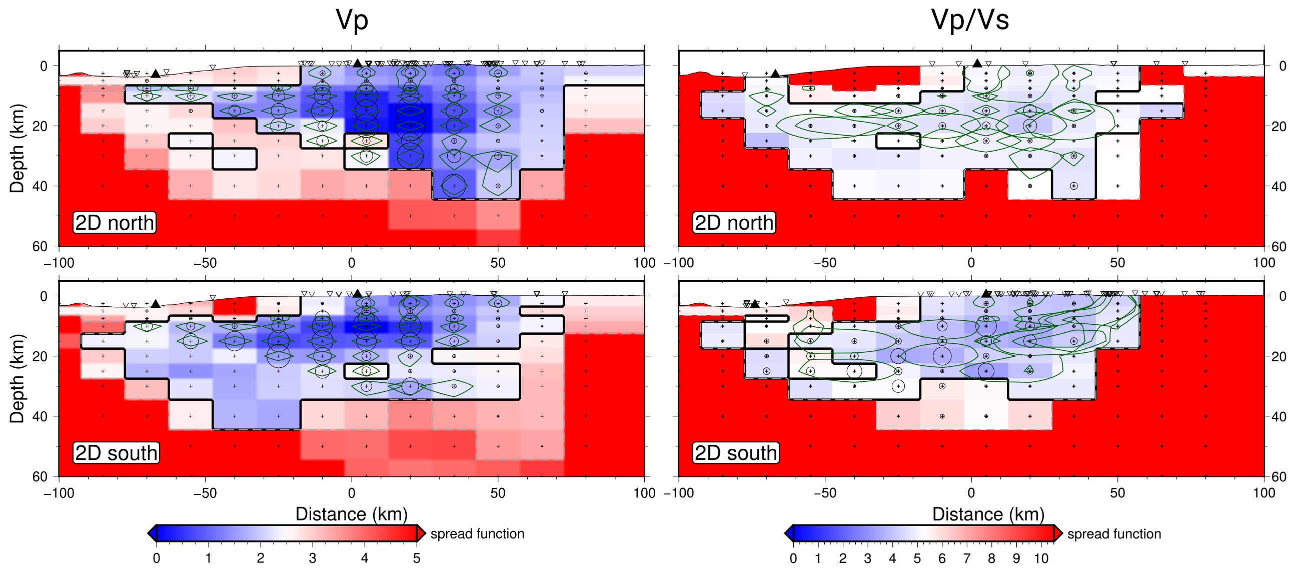

Figure 2: **2D model resolution matrix (MRM).** Resolution contour estimation for the 2D Vp and Vp/Vs models in the north and south segments. Based on the MRM analysis, calculation of the spread function is dipslayed in a red/blue scale. Green lines show the 70% contour for the diagonal elements of the MRM.

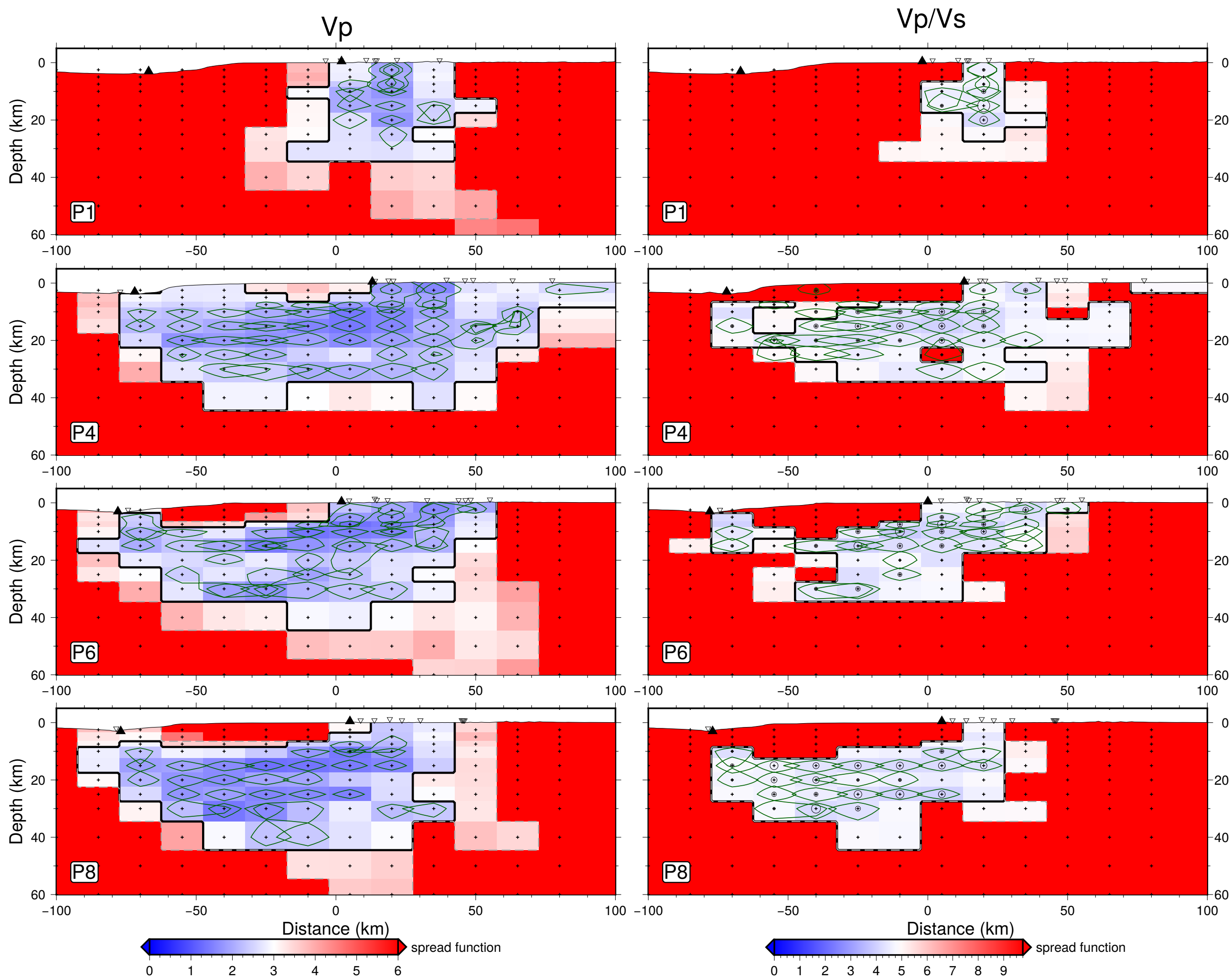

Figure 3: 3D model resolution matrix (MRM). Resolution contour estimation for the 3D Vp and Vp/Vs along representative profiles for the northern, central and southern parts of the area of study. Based on the MRM analysis, calculation of the spread function is shown by a red/blue scale. Green lines show the 70% contour for the diagonal elements of the MRM. See text for further information.

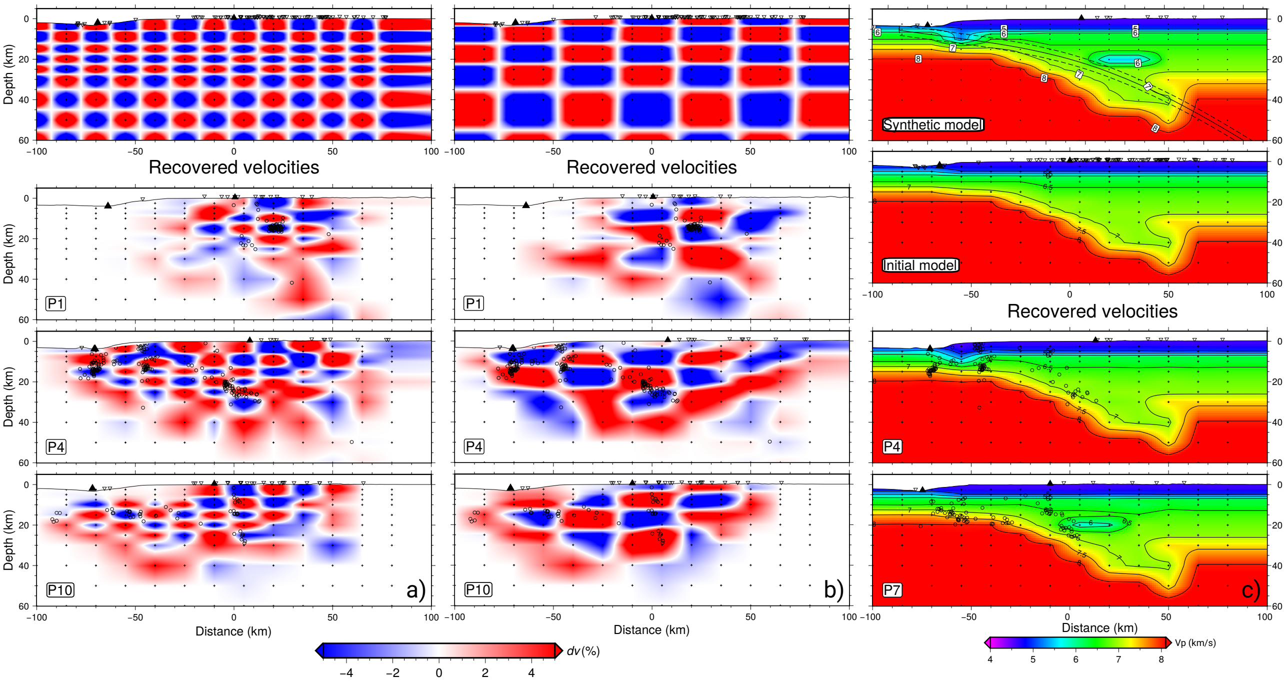

Figure 4: **Synthetic recovery tests.** Checkerboard test for **a)** small, 15km and **b)** medium, 30 km anomalies. Top image show the input model comprised by alternated positive and negative anomalies of $\pm5\%$ of the inverted model. Bottom images show the recovered velocities along representative profiles for the northern, central and southern segments in our region of interest. **c)** Restoring test for a seamount represented by low Vp (5.0 km/s) anomalies added in P4 and a low velocity anomaly (5.5 km/s) at 20 km depth in P7. Projection of the synthetic and initial model are shown at the top. See Figure S4 and S5 for furhter details.

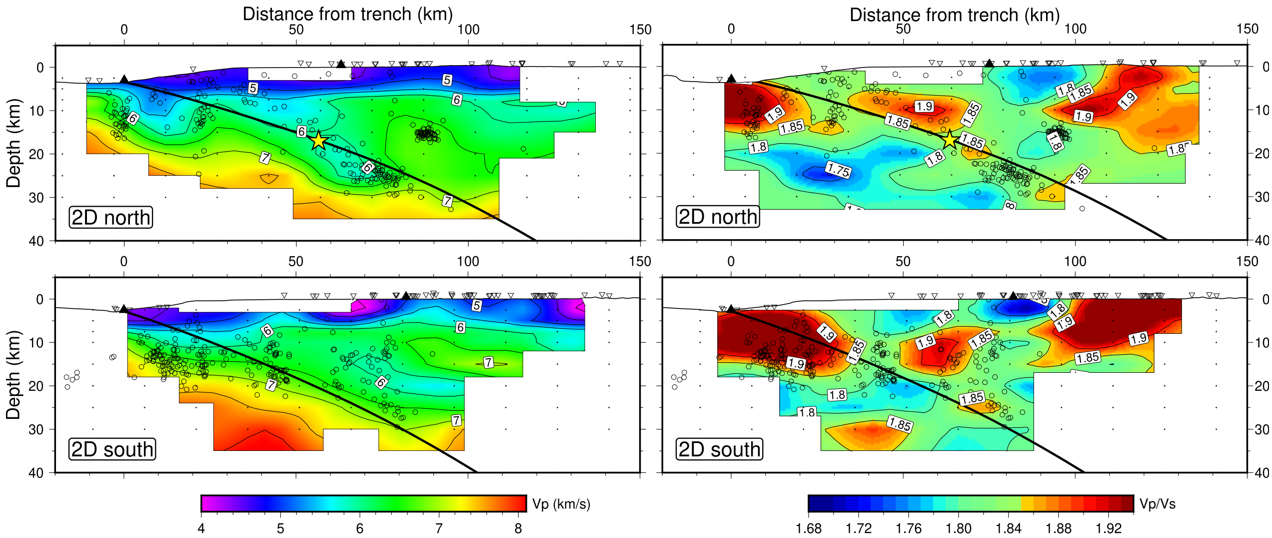

Figure 5: **2D velocity model.** Two-dimensional models for both north (top) and south (bottom), Vp (left) and Vp/Vs (right). Velocities and Vp/Vs ratios are color coded and iso-contours are plotted every 1.0 km/s and 0.025 for Vp and Vp/Vs, respectively. Based on resolution estimated by the MRM and checkerboard test, results for non resolved areas are shown faded or blank. Relocated hypocenters are plotted in black circles and grid nodes are shown in black crosses. Yellow star in north, Vp and Vp/Vs, profiles indicates the epicenter for the 2016 Pedernales earthquake (Nocquet et al., 2017). Solid black triangles represent the projection of the trench (Collot et al., 2005) and coastline. Modified slab interface (see text for further details) is represented by solid black line. Finally, inverted triangles are the stations contained on each profile.

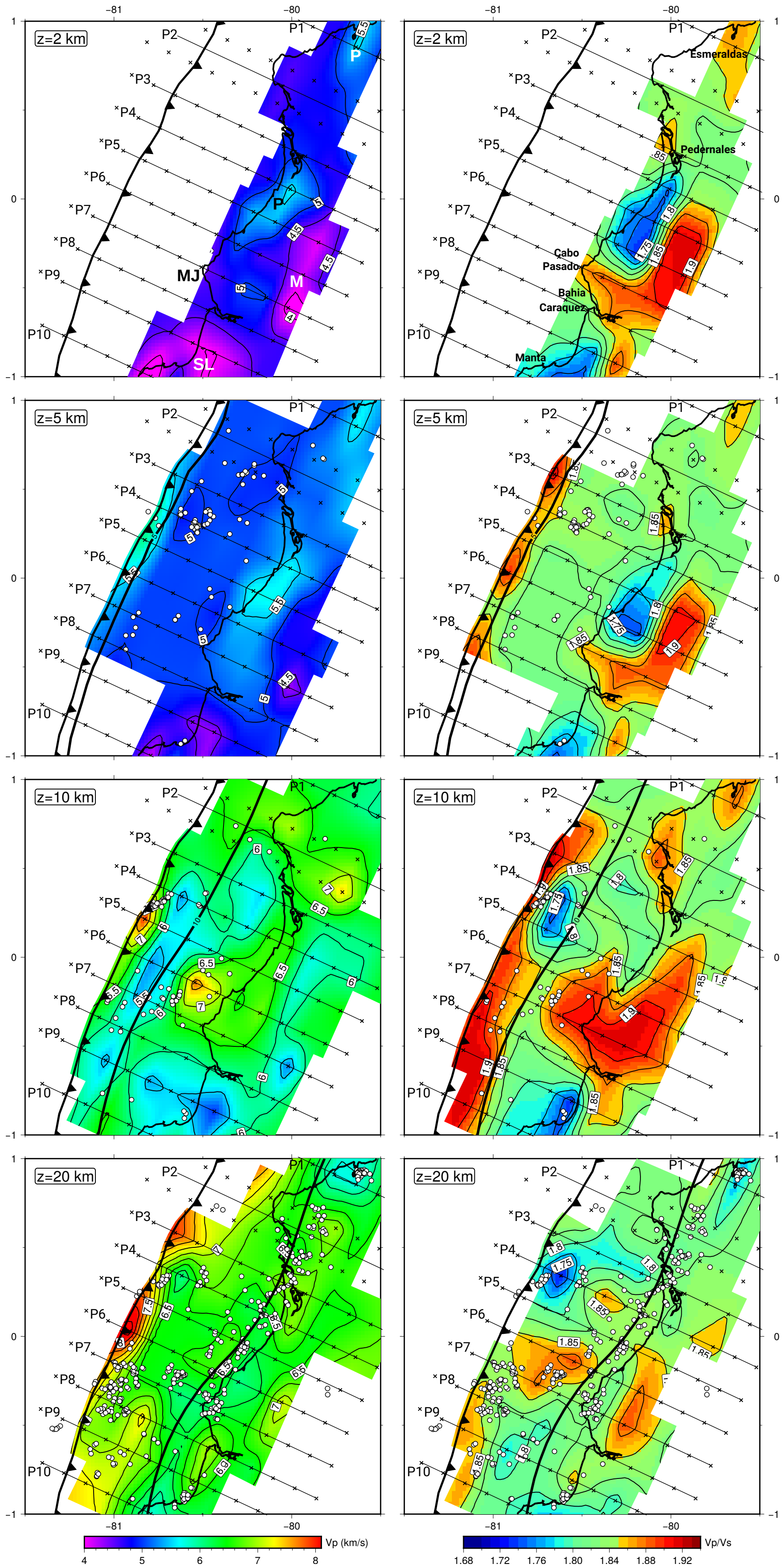

Figure 6: **3D velocity model, horizontal slices.** Vp (left) and Vp/Vs (right) horizontal slices at 2, 5, 10 and 20 km depth. Velocities and Vp/Vs ratios are color coded and iso-contours are plotted every 1.0 km/s and 0.025 for Vp and Vp/Vs, respectively. Based on MRM and checkerboard test, non resolved areas are blank. Velocity anomalies colocated to surface observations from Reyes and Michaud (2012) and cities referred in text are shown in z=2 km. Profile and grid nodes locations are displayed by black solid line and crosses, respectively. Corresponding slab depth contour is represented by a thick black line. Seismicity is plotted by depth (d) following: d≤5 km in z=5 km, 5<d≤10 km in z=10 km and d>10 km in z=20 km. P: Piñon outcrop, M: Manabi basin, MJ: Manta-Jama basin and SL: San Lorenzo block.

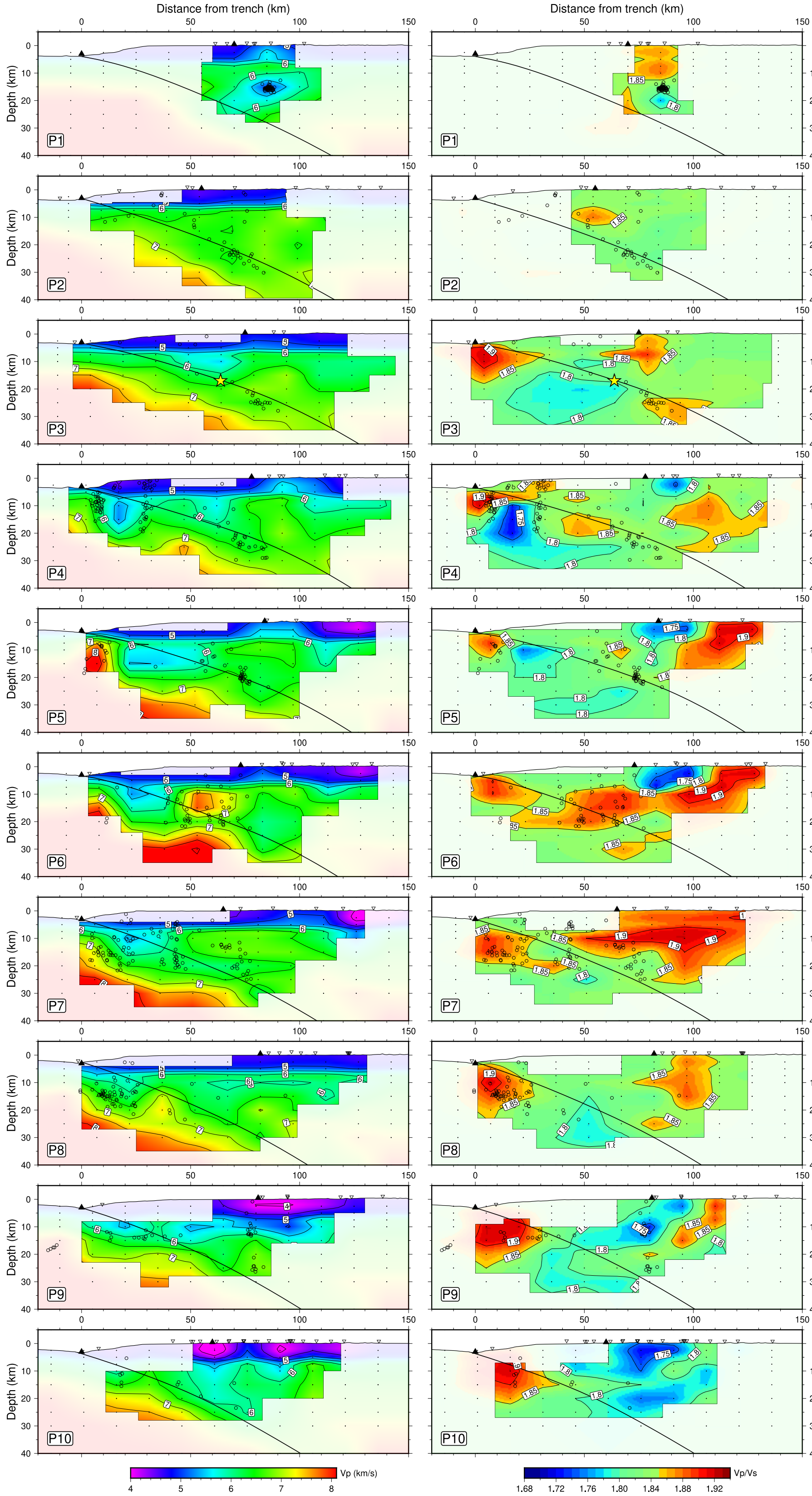

Figure 7: **3D velocity model, cross sections** Three-dimensional models for both Vp (left) and Vp/Vs (right) based on the inversion of a smooth initial 2D initial model and 2D-N and 2D-S arrival times. Results are shown along 10 W-E profiles. Vp velocities and Vp/Vs ratios are color coded and iso-contours are plotted every 1.0 km/s and 0.025 for Vp and Vp/Vs, respectively. Based on the MRM and checkerboard test, non resolved areas are faded. Location of profiles, P1-P10, is shown in Figure 1. Width for projection of hypocenters and stations is 22 km. Relocated hypocenters are plotted in black circles, and stations are represented by inverted triangles. Grid nodes are displayed in black crosses and solid black triangles represent the projection of the trench and coastline. Yellow star in P3 indicates the hypocenter for the 2016 Pedernales earthquake (Nocquet et al., 2017). Modified slab interface (see text for further details) is represented by solid black line.

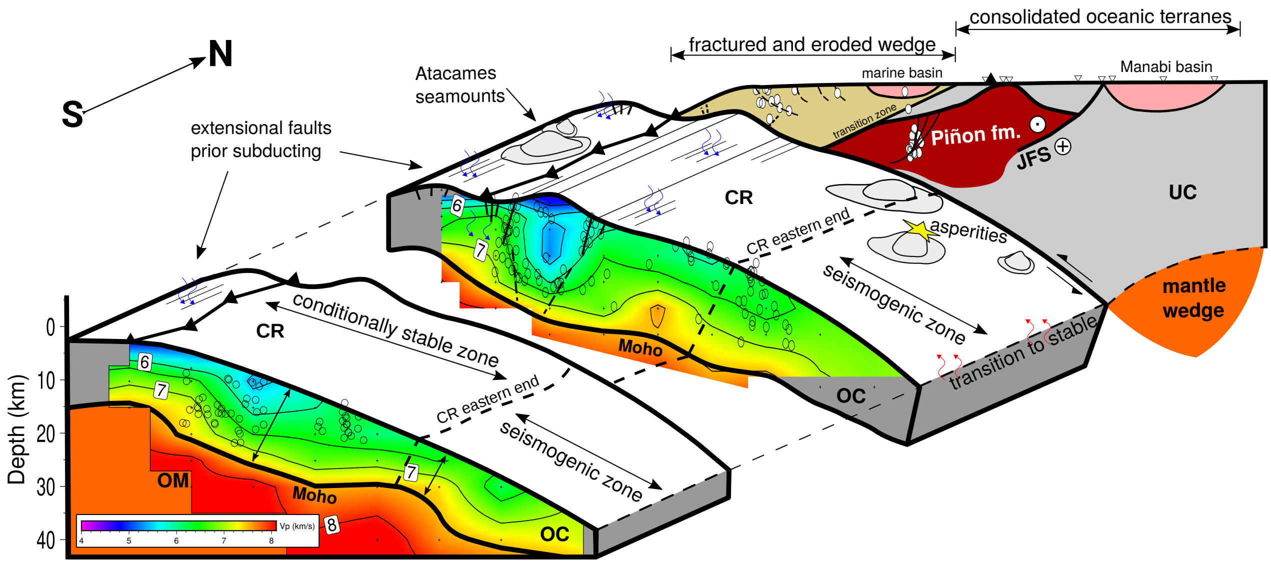

Figure 8: **Interpretative sketch.** Structural synthesis based on the main findings of this work around profile P4 and P7. UC: upper plate crust, OC: oceanic crust, OM: oceanic mantle, CR: Carnegie Ridge, JFS: Jama fault system, with strike-slip displacement indicated by the dot and cross. Vp velocities at P4 and P7 are projected in cross sections. Hypocenters are shown in circles. Black triangles represent the trench axis and the coastline. Inverted triangles indicate station locations. Yellow star represents the epicentre of the 2016 Pedernales earthquake (Nocquet et al., 2017). Arrows in the front panel indicate the thickness of the OC. We observe a thinning of the OC at depths ∼20-30 km which we interpret as the eastern end of the CR. Vertical scale exaggeration 1:1.5.