# Mantle Dynamics of the Andean Subduction Zone from Teleseismic S-Wave Tomography

**E.E. Rodríguez[1], D.E. Portner[1], S.L. Beck[1], M. Rocha[2], M. Bianchi[3], M. Assumpção[3], M. Ruiz[4], P. Alvarado[5], C. Condori[3]**

*[1]Department of Geosciences, University of Arizona, Tucson, Arizona, USA*

*[2]Instituto de Geociências, Universidade de Brasília, Brasília, Brazil*

*[3]Centro de Sismologia, Departamento de Geofísica, Instituto de Geofísica, Astronomia, e Ciências Atmosféricas, Universidade de São Paulo, São Paulo, Brazil*

*[4]Instituto Geofísico, Escuela Politécnica Nacional, Quito, Ecuador*

*[5]Consejo Nacional de Investigaciones Científicas y Técnicas, Departamento de Geofísica y Astronomía, Facultad de Ciencias Exactas, Físicas y Naturales, Universidad Nacional de San Juan, San Juan, Argentina*

The western margin of South America has experienced a long history of subduction, creating a long continuous subduction zone. The oceanic Nazca plate subducts eastward beneath the South America plate forming the Andean Subduction Zone, which extends for more than 7,000 km along-strike. We present a comprehensive, finite-frequency S-wave tomography model for the Andean Subduction Zone by combining data from more than 1,000 seismic stations deployed across South America. By inverting for the entire subduction zone in a single model, we are able to fully contextualize previously imaged anomalies, including the subducted Nazca slab. Our new model illuminates the structure of the slab from ~150 km to ~1100 km depth. The geometry and amplitude of the slab anomaly varies along strike, however the slab appears continuous into the lower mantle, where we have resolution. Beneath northern Brazil, the Nazca slab is observed to stagnate at ~1000 km depth. This contrasts with the imaged slab to the south, where it does not appear to stagnate.

Surrounding the slab, we image several high amplitude anomalies. The first of which, is a slow velocity anomaly extending from near the top of the slab at the mantle transition zone to ~150 km depth beneath the region of the Bolivian Orocline (15-18°S). This anomaly is coupled with the disappearance of the fast velocity slab anomaly, between ~500 and 660 km depth, where the slow anomaly appears to originate. Teleseismic P-wave tomography studies of this region observe no change in slab anomaly amplitude (Scire et al., 2016, 2017; Portner et al., 2019). This may suggest a localized region of high Vp/Vs, which we interpret as hydrated mantle from the dehydration of the slab in the lower mantle.

The second slow velocity anomaly is imaged beneath eastern Brazil at 22-27°S and has previously been interpreted as the 'Paraná plume' (e.g. VanDecar et al., 1995). In our model, this vertical slow velocity anomaly appears directly adjacent to the subducted fast Nazca slab anomaly, where it flattens at ~1000 km depth. Previous imaging studies have hinted at such an interaction but have been limited by their apertures. By inverting for the full structure of the Nazca slab and Andean Subduction Zone, we're able to delimit shallow structures from the slab itself, revealing the slow velocity anomaly to be in direct contact with the slab. We suggest a re-interpretation of this anomaly as a focused upwelling formed at the edge of the Nazca slab as a consequence of slab penetration and stagnation in the lower mantle.

Portner, D.E., Rodríguez, E.E., Beck, S.L., Zandt, G, Scire, A., Rocha, M., Ruiz, M., Alvarado, P., França, G.S., and Condori, C., 2019. Detailed structure of the subducted Nazca slab into the lower mantle derived from continent-scale teleseismic P-wave tomography, submitted to J. of Geophys. Res.

Scire, A., Zandt, G., Beck, S., Long, M. and Wagner, L., 2017. The deforming Nazca slab in the mantle transition zone and lower mantle: Constraints from teleseismic tomography on the deeply subducted slab between 6° S and 32° S. Geosphere, 13(3), p.665-680.

Scire, A., Zandt, G., Beck, S., Long, M., Wagner, L., Minaya, E. and Tavera, H., 2016. Imaging the transition from flat to normal sub
duction: variations in the structure of the Nazca slab and upper mantle under southern Peru and northwestern Bolivia. Geophys. J. Int. 204, 457–479.

VanDecar, J.J, ames, D., Assumpcao, M., 1995. Seismic evidence for a fossil mantle plume beneath South America & implications for plate driving forces. Nature. 378. 25-31. 10.1038/378025a0.