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Variable seismic anisotropy along the South American coast caused by changes in slab structure and mantle dynamics

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Observations of shear wave splitting have provided constraints on patterns of deformation in the mantle in a variety of tectonic settings, including those with highly complex patterns of mantle flow such as subduction zones. The South American subduction system is characterized by the longest continuous subducting slab present today, with the trench spanning over ∼7000km. As such, it is an excellent natural laboratory to examine variability in anisotropy along several thousand kilometers of a subduction zone with fluctuating slab dips. We perform shear wave splitting analyses at 67 stations along the Chilean coast spanning over 2500 km of the subducting South American slab. When combined with previous shear wave splitting studies, we amass a dataset that spans from Peru to Patagonia. Along the coast, we see a stark transition in splitting from the central Bolivian Orocline to southern Chile, indicative of a transition in mantle dynamics beneath the subducting slab from convergent flow beneath the Orocline to trench parallel flow further south beneath Chile north of the Pampean flat slab. This supports previous assertions of mantle dynamics in the region first proposed by Russo and Silver [1994] where a stagnation point exists beneath the Bolivian Orocline with trench parallel flow to both the north and south. Beneath the Peruvian flat slab to the north and the Pampean flat slab to the south, rapid changes in shear wave splitting are observed. We interpret these as deviations in mantle dynamics due to variations in subducting slab structure. This is most obvious beneath the Pampean flat slab where a large slab hole has been observed tomographically and aligns coincidently with a restricted region of anomalous shear wave splitting.