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Caribbean slab dynamics beneath northwest South America from SKS and Local S splitting

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The southernmost edge of the Caribbean (CAR) plate, a buoyant large igneous province, subducts shallowly beneath northwestern South America (NWSA) at a trench that lies northwest of Colombia. Recent finite frequency P-wave tomography results show a segmented CAR subducting at a shallow angle under the Santa Marta Massif to the Serrania de Perijá (SdP) before steepening while a detached segment beneath the Mérida Andes (MA) descends into the mantle transition zone. The dynamics of shallow subduction are poorly understood. Plate coupling between the flat subducting CAR and the overriding NWSA is proposed to have driven the uplift of the MA. In this study we analyze SKS shear wave splitting to investigate the seismic anisotropy beneath the slab segments to relate their geometry to mantle dynamics. We also use local S splitting to investigate the seismic anisotropy between the slab segments and the overriding plate. The data were recorded by a 65-element portable broadband seismograph network deployed in NWSA and 40 broadband stations of the Venezuelan and Colombian national seismograph networks.

SKS fast polarization axes are measured generally trench-perpendicular (TP) west of the SdP but transition to trench-parallel (TL) at the SdP where the slab was imaged steepening into the mantle, consistent with previous studies. West of the MA the fast axis is again TP but transitions to TL under the MA. This second transition from TP to TL is likely due to mantle material being deflected around a detached slab under the MA. Local S fast polarization axes are dominantly TP throughout the study area west of the Santa Marta Massif and are consistent with slab-entrained flow. Under the Santa Marta Massif the fast axis is TL for reasons we do not yet understand.