Evidence for Caribbean Plate subduction in Southern Costa Rica

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Abstract: Nestled between the Cocos, Nazca, Caribbean, and the South American Plates, the Panama Microplate represents an area of rapidly evolving tectonics throughout the last ~10 Ma. Past and current studies have observed a notable amount of seismicity throughout this region, in particular the Caribbean coast of Costa Rica, which experienced a Mw 7.7 earthquake in 1991. In this study, we investigate the crust and upper mantle structure of this region using the receiver function methodology, and report two results 1) first-order lateral constraints on the position of the Panama Microplate boundary near the intersection between the Central Costa Rican Deformed Belt (onshore) and North Panama Deformed Belt (offshore), and 2) an impedance contrast south and east of these belts, supporting that the Caribbean Plate currently subducts beneath the Panama Microplate. Observed local seismicity is a consequence of the recently (~14 Ma) initiated Caribbean Plate subduction beneath the overlying Panama Microplate. Our results are also consistent with a doubly convergent, orogenic subduction margin dominating southern Costa Rica tectonics, likely uplifting the Talamanca Cordillera, and causing the cessation of southern Costa Rica volcanism over the past ~10 Ma.

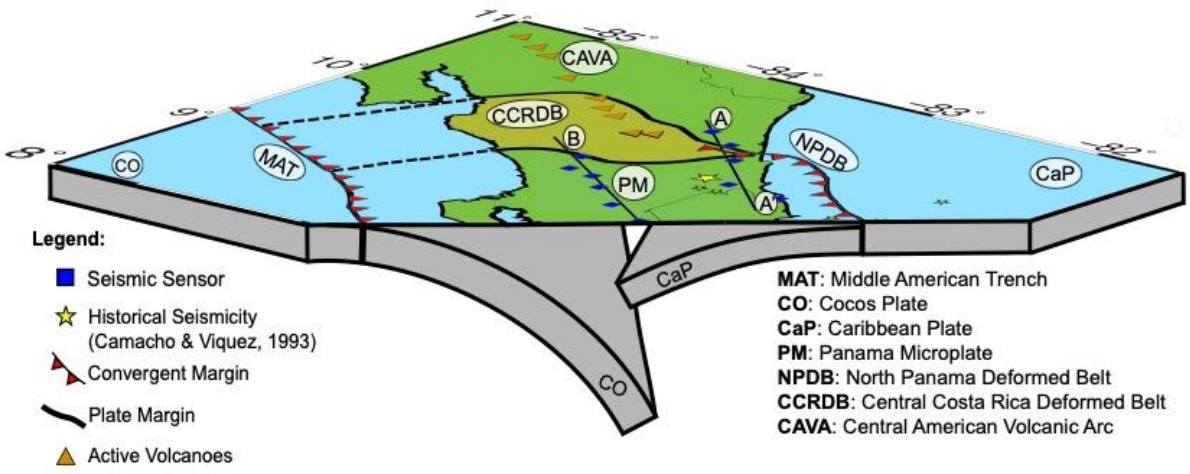

Figure: Schematic diagram of the tectonic and upper mantle structure of southern Costa Rica. The Cocos Plate subducts steeply to the northeast beneath Costa Rica (Lücke and Arroyo, 2015; Dzierma et al., 2011). On the Caribbean coast, the Caribbean Plate subducts beneath Costa Rica and Panama and plunges ~50-60 km beneath southern Costa Rica (Arroyo and Linkimer, 2021; this Study).