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Active Thrusting in the Inner Fore arc of Middle America, Costa Rica

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The Fila Costena is an active thrust belt within the forearc basin of the Middle America convergent margin in Costa Rica, with a rate of shortening that represents a significant proportion of the rapid convergence between the Cocos and Caribbean plates. New geologic mapping of this thrust belt between the Panama border on the east and the Terraba gorge on the west depict a duplex with 3-4 horses that incorporate Eocene limestones and clastics of the Oligocene-early Miocene Terraba Formation. A thrust sheet at the rear of the thrust belt displaces the entire basin sedimentary sequence, including the Pliocene Curre Formation. All the thrust faults are emergent and cut the synorogenic land surface in the mapping area. Cross sections were constructed along two NE-SW trending transects across the thrust belt at the Terraba gorge and near the town of Guaria on the Pan-American Highway. Estimates of fault slip based on cutoffs of Eocene limestones on these sections are 4.2 km, 5.4 km, 5.0 km and 6.6 km for the four thrust sheets in the Terraba gorge, where hanging wall cutoffs are exposed, to 4.5 km, 5.5 km, 6.3 km, 8.1 km, and 11.9 km for the five thrusts in the Guaria area, where only minimum estimates of shortening were possible. The Eocene limestones at the base of thrust sheets pinch out to the west due to decreasing slip on faults and/or a lateral ramp in the basal decollement. To the east, the duplex terminates abruptly near the Panama border at the on-land projection of the subducting Panama Fracture Zone, suggesting that shortening is propagating rapidly to the east with the migration of the triple junction and the onset of rapid shallow subduction of thickened Cocos plate. Total shortening is greatest in the vicinity of Guaria, where the restored cross section shows 36 km of slip, as compared to 21 km near the Terraba gorge. Minimum long-term shortening rates are constrained by the presence of faulted Pliocene marine sediments in the thrust belt. The time since the passage of the Cocos-Nazca-Caribbean triple junction, migrating southeast at approximately 50 mm/yr, provides a maximum shortening rate based on the assumption that lateral propagation of the thrust belt is smooth and not episodic. It is estimated that the rates of active thrusting at the front of the Fila Costena are between 0.34 mm/yr and 1.5 mm/yr, based upon marine terrace development (Fisher et al., Tectonics, 2004). These uplift rates, determined from uplifted marine terrace elevations, correspond to the dip on the underlying faults, as exhibited on structural maps. Where the thrust belt extends offshore in the east, there is a regionally extensive marine platform where erosion largely keeps pace with the thrust rate. Comparatively, inboard of the subducting Cocos ridge the thrust front lies inland and the total shortening is greater. The south sides of the prominent ridges within this emergent thrust front are sites of extensive landsliding, with deposits up to 39 sq. km. A minimum of 40% of the total Cocos-Caribbean convergence is

taken up by shortening of the inner fore 80 km inland from the active trench. Absence of similar features in the Nicaraguan forearc where the subducting crust is older, subducts more steeply, and lacks incoming ridges and seamounts indicates that demise of the forearc basin in Costa Rica reflects the greater coupling inboard of the Cocos Ridge.

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