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Does the South American plate margin geometry promote tectonic escape, buttressing and high sediment loads in western Colombia?

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Major (Mw>5) earthquakes (Global CMT database) located in the Ecuador-Colombia subduction zone, and GNNS vectors (Colombian Geological Survey – GEORED database) on the continental western South America border between latitudes S3º and N6º, prove the ongoing partial decoupling of the plate convergence. Due to the margin geometry, the obliquity of the Nazca plate convergence exceeds 25º with respect to trench azimuth for the latitude interval 0º-N5º, and may achieve values as high as 36º between latitudes N3º and N4º, to decrease far north to zero. Although not calculated, the Central American margin continuation seemingly mirrors the geometry issues described for the South American side.

Averaged slip vectors from subduction earthquakes slide only 10º to trench-normal in the obliquity region. As a result, a forearc sliver (-the Western Cordillera block-) theoretically should move towards the northeast parallel to the margin at rates exceeding 10 mm/yr. In fact, GNNS vectors (ITRF frame-absolute motions) measured in coastal stations are as rapid as 20 mm/yr or more (also northeasterly), and in other inland locations may achieve 14 mm/yr or more, all becoming faster by increasing latitude positions up to nearly N5º. These inland vectors maintain a positive difference by at least 3 mm/yr compared with the stations distributed farther in the east flank of the dextral-inverse Romeral fault zone. Therefore, the North Andean Block, assumed to escape due to the rapid Nazca plate and Carnegie ridge subduction in the Ecuadorian margin, translates toward the northeast slower than the obliquity-detached Western Cordillera block.

Between latitudes N4º and N8º, the locking to the tectonic transport and the development of an oroclinal bending in a maximum compressional zone become evident. The region encompasses a >200 km longitude maximum-elevation orographic belt that coincides with the south-to-north Tatama-Citara-Frontino-Paramillo massifs in the Western Cordillera (maximum elevations ranging on 3,900-4,200 m a.s.l.), and also with the westernmost Baudo and Darien massifs (< 2,000 m a.s.l.). The buttressed region encloses the highly-rainfall hinterlands of the San Juan, Baudo and Atrato rivers, which combined, represent a cumulative suspended load in excess of 36 MT/yr that is delivered to the lowlands and coastal zones. By considering other small-to-medium size drainage areas that surround the highlands in the buttressed region and farther south in the Western Cordillera block, the sediment load into the Pacific Ocean is by far remarkable, namely 110 MT/yr as previously estimated (including San Juan but excepting Atrato), and generates conspicuous medium-size river deltas such as Mira, Patía and San Juan in the Pacific, and Atrato in the Caribbean.

Keywords: Colombia; Nazca subduction; South American plate; Partial decoupling; Forearc sliver; Buttress effect; Sediment load; Pacific rivers.