



Plio-Quaternary canyons evolution on South Colombian convergent margin : Tectonic causes and implications

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Investigations of seafloor morphology and sediment deposits associated with the incision of the South Colombia active margin by a major submarine canyon system are used to reveal out-of-sequence fault activity at least since the Middle Pleistocene. The South Colombian convergent margin is located along Northwestern South America, where the Nazca plate underthrusts eastward the South America plate with a 58 mm.yr⁻¹ convergence rate. The morphology and deep multichannel seismic reflection lines obtained across the margin reflect a frontal accretionary wedge, as well as antiformal and faulted internal structural highs that locally extend up to near the continental shelf, suggesting wide-spread Plio-Quaternary tectonic activity. The Amadeus cruise conducted in 2005 brought new seismic and sedimentary data together with 150m and 60m-resolution EM12D multibeam bathymetry. The newly mapped Mira and Patia canyons system incises the South Colombian margin slope over a distance of ~90 and ~150 km respectively, forming an unequivocal Z-shape in map view, breaching the deformation front and feeding a 30-km wide trench fan system. The morphology of the canyon exhibits meanders, steep over-incised walls (~25-30 degrees), alternation between concave-up and convex-up downstream profiles, slope failure scars, and buried channels. These features reflect interactions between tectonics, sedimentation and the canyon evolution.

A synthesis of all the data reveals that: A) Uplifting structural highs control canyons path and incision stages. B) Canyons developed asynchronously across the upper, mid and lower margin slopes according to three main stages: a) upper slope incision by downward cutting during Pleistocene, and possibly by retrogressive headward erosion, b) infill of a mid-slope basin bounded by uplifting structural highs, and c) overspill of the slope basin, and breaching its seaward bounding ridge, and the accretionary prism ~150 kyr ago. These processes led to the construction of sedimentary lobes in the trench, and then to a well-developed channel-levees system. C) Occurrences of antecedence, canyon walls over steepening, and convex-up bathymetric profiles of the canyons imply uplift of the fault-controlled structural highs at least during the last ~150 kyr supporting active out-of-sequence tectonic shortening. The long-term causes of the out-of-sequence tectonic could be linked to interplate coupling and basal friction variations. This study strongly reflects the interplay between tectonic deformation and canyon evolution thus providing a good example of the use of canyon morphology and associated deposits as markers of active tectonic deformation