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The Esmeraldas Canyon: a helpful marker of the Pliocene-Pleistocene tectonic deformation of the north Ecuador southwest Colombia convergent margin

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Deciphering the migration pattern of the Esmeraldas submarine canyon (EC) and its history of cut-and-fill allows constraining the Pliocene-Pleistocene tectonic evolution of the Ecuador-Colombia convergent margin. Swath bathymetry, multichannel seismic reflection and chronological data show that the EC is a 143-km–long, shelf-incising, river-connected canyon that started incising slope apron deposits in the Manglares fore-arc basin ~ 5.3 Ma ago, reflecting an increase of the fore-arc uplift. The EC inception appears contemporaneous with the subduction of the Carnegie Ridge that is believed to have initiated 5-6 Myr ago and is considered an indirect cause of the EC formation. During its two-stage left-lateral migration, the EC upper-half scoured deep incisions in the margin wedge providing evidences for uplift episodes in the Manglares basin. The two stages are correlated with mid-Pliocene and early-Pleistocene regional tectonic events identified in the onshore geological records. Two EC segments located upstream and downstream of a mid-slope EC stretch that recorded Pliocene-Pleistocene sedimentation, were uplifted by 300-450 m since the early Pleistocene in response to local tectonic activity for the downstream canyon segment, and more regional tectonic events for the upstream canyon segment. Glacio-eustatic variations significantly contributed to shape the EC and its upslope tributaries by increasing the rate of canyon incision during middle to late Pleistocene rapid sea level falls, thus reinforcing the effect of tectonics, which appears to be the main triggering factor for the incisions and the lateral migration of the EC. Faulting and folding as well as diapiric structures have structurally controlled the location of the EC as well as its Atacames and Sua tributary canyons, whereas the Same tributary canyon would have initiated on a mass transport deposited in a paleo-scar. The NE-trending Ancon fault system and its underlying splay fault, which deform the lower margin slope, controlled the Ancon tributary canyon, which has been cut from its sedimentary source ~170 kyr ago by the growth of a fault-related anticline. The margin wedge that hosts the EC is highly unstable as it is cut by active faults and shaken by large subduction earthquakes. Several mass transport deposits have dammed the canyon, one of them between >~65 and ~37 kyr causing an impoverishment of detrital material in the trench sedimentation and an interruption of the trench paleoseismological record. In conclusion, the EC offers a quite detailed recording of the Pliocene-Pleistocene tectonic deformation of the margin, confirming the tectonic events of regional importance identified onshore. These events affected the outer part of the margin, while they are distinguished from local tectonic activity governed by the subduction front.