Geophysical Research Abstracts
Vol. 13, EGU2011-9926, 2011
EGU General Assembly 2011
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Evidences for a sub-marine active fault along the North-Ecuador South Colombia oblique-convergent margin: implication for fault maturity and tectonic escape

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The North Ecuador-South Colombia margin is undergoing a 58mm/yr E-W convergence with a ∼30° obliquity. The recently discovered submarine trench-parallel Ancon Fault (AF) system cut through the margin ∼20 km from the deformation front. The margin was affected in1906 by a Mw 8.8 subduction earthquake that ruptured a ∼500 km –large area, partially reactivated by three smaller events with adjacent rupture zones from south to north in 1942 (Mw 7.8), 1958 (Mw 7.7), and 1979 (Mw8.2). The seaward boundary of the 1958 rupture zone and aftershocks has been correlated with a crustal splay fault. Based on MCS and OBS data, the fault is inferred to connect at depth with the interplate décollement. Extensional structures, which are part of the Ancon Fault system, are associated with the seaward shallow termination of the splay fault. Major splay faults, because of their relatively high dip-angle and their rooting on the interplate décollement are potentially tsunamigenic. To assess the hazard related to the AF fault rupture, 3D geometry of the fault and evidence for tectonic activity need to be documented.

In this study we used high resolution (25 m) multibeam bathymetry, MCS data (∼10m vertical resolution), Chirp seismic data (∼0.5m vertical resolution), and sedimentary cores to constrain the 3D geometry and Holocene activity of the AF system. The data reveals three distinct fault segments with specific characteristics. 1) The southern AF segment trends ∼N080, is 30km-long and connects with a section of the deformation front that shows an apparent 15-km dextral offset, where seamounts impinge upon the margin. The fault segment shows a sigmoid pull-apart structure revealing small (<1 km) dextral strike-slip displacement, typical of an immature fault; this observation suggests that the fault segment might be related to the recent impingement of the deformation front by subducting seamounts. 2) The middle AF segment trends ∼N060 and is 40 km-long. It consists of en-échelon scarps related to the shallow extension associated with the splay fault. 3) The northern AF segment trends ∼N030 and consists of a linear 30 km-long scarp that appears to be a crustal fault according to MCS data. Its linearity and sub-vertical dip suggests a mature, slightly back-thrust fault with a possible strike-slip component, likely dextral according to the regional kinematics. Sediment at the transition between middle and northern segments is deformed by a double anticline indicating transpression, whereas the northern extent of the Ancon fault reveals a horse-tail structure. The contrasting deformation styles observed along the AF segments support maturity stages that vary from immature in the south to mature in the north. A deformed ash layer visible in Chirp data and identified in cores collected along the Ancon fault provide evidence for tectonic activity along the middle and northern fault segments over the last ∼5300 years. The absence of systematic turbidites in two out of three small basins associated with the fault trace does not allow discriminating co-seismic from inter-seismic deformation. These preliminary results show partitioning of the deformation at the very front of the margin and likely outline an initial stage of lateral tectonic escape.