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Seismic evidences for complex faulting through the Gulf of Guayaquil, Ecuador

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Along the Ecuadorian margin, the North Andean Sliver is moving in the northeastward direction due to the oblique subduction of the Nazca plate. The opening of the gulf of Guayaquil is a consequence of this motion. Two principal models compete to explain the opening. One proposes an opening achieved essentially with strike slip motion along a single major fault through the gulf, the other with a combination of strike slip and normal faulting on both sides of the gulf. The consequences in term of seismic hazard are very different. A single strike slip fault model could imply a long fault segment capable of generating large magnitude events. In contrast, a multi segments composite fault system will give conditions for producing small to medium size earthquakes. The southern Ecuador subduction zone is characterized by the absence of large historical earthquake. Data from the historical and instrumental seismicity for magnitude above 4 show the fore arc has a high level of seismic activity within and around the gulf that connects to the crustal seismic activity of the volcanic arc. In contrast, the fore arc elsewhere shows very little or no seismic activity between the interplate zone and the volcanic arc. Regional and global CMTS data show mostly diffuse strike slip mechanisms that do not line up on a single fault system. We present new earthquake data from the recently upgraded national seismic network of Ecuador. They provide the first image of SW-NE trending crustal faults stretching in the central part of the gulf and running eastward between Puna island and the southern coast of the gulf. It appears to be a complex multi segments fault system. The observed seismic alignments do not cross the Puna island as it was postulated in previous regional tectonic studies. Others seismic clusters are observed parallel to the northern coast of the gulf, indicating active structures eventually accommodating the North South opening of the gulf through normal faulting.

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