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Ten years of multidisciplinary approaches to unveil the crustal active tectonics in Ecuador

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The Ecuador region is an outstanding natural laboratory to study the historical and prehistorical seismicity, the earthquake recurrence through recent times, not only along the subduction zone but on the Andean crustal faults as well. Taking advantage of team projects funded by our national funding agencies, Phd projects and the SVAN international laboratory between France and Ecuador for the last 10 years, we focused on studying the surface deformation patterns in relation to the regional geodynamic settings (e.g. Yepes et al., 2016), providing updated hints to better constrain seismic hazards (e.g. Beauval et al., 2018).

Intense historical and instrumented seismicity as well as geodetic measurements have shown that the crustal deformation is dominated by the northeastward motion of the Northern Andean continental Sliver (Nocquet et al., 2014). This sliver is bounded by a newly defined major structure, the Chingual-Cosanga-Pallatanga-Puna (CCPP) fault system, which cuts the South American plate from the Gulf of Guayaquil to the Caribbean, and fits with the description of a continental plate boundary similar in many ways to the Marlborough Fault system in New Zealand (Alvarado et al., 2016). It has produced several large M~7 earthquakes, like the 1797 Riobamba earthquake which yielded over 25,000 casualties (Egred, 2000) and is the source of a current and moderate seismicity in the Guayaquil gulf area (Régnier et al., this meeting) as well as surface-rupturing moderate events in the eastern Cordillera (Champenois et al., 2017). Off the CCPP fault zone, a recurrent moderate seismicity is associated with the North-South fold and thrust faults that stretch within the sliver. The stunniest cases are the Quito fault-related fold (Alvarado et al., 2014), or the complex fault system of Ibarra/Billecocha Fault, the potential source of M7.2 1868 earthquake (Saqui et al., this meeting). The overall tectonic scheme now available allows discussing the geodynamic processes, such as regional uplift, crustal thickening, sliver extrusion, suture reactivations, inter-seismic coupling (Cisneros et al., this meeting), as well as the interaction between magmatism and tectonism (Bablon et al., 2018; Espin et al., this meeting). This comprehensive team work now permit to properly characterize the active fault systems, assess its contribution to the Andean geodynamics; including their seismic potential, magnitude and frequency of forthcoming earthquakes, which are inputs for seismic hazard assessment studies.

Our complementary team have confirmed the usefulness of multidisciplinary approach and validated the need to keep up in the future. Volcanic marker dating, microseismicity analysis and geodesy offers a unique chance to reveal interseismic and coseismic deformation (Champenois et al., 2017; Marinière et al., submitted) and complement geological data and models (Alvarado et al., 2016). However, several key places with challenging geodynamic and hazard issues still critically need additional constraints to properly model the source of the observed deformation, as the Eastern Cordillera and Subandean regions (1995 M7).